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THE GOLDEN AGE OF BOTANY[1]

By Dr. EDGAR N. TRANSEAU

THE OHIO STATE UNIVERSITY

THOSE of us who were so fortunate as to enter the field of botany about the beginning of the century have witnessed the period of its greatest growth and differentiation. In no other country and at no other time have there been so many undergraduate students of botany, so many graduate students and so many botanists employed in educational and research institutions. We vividly recall that this 40-year period began just after the Spanish-American war when America took over the Philippine Islands. We have likewise had a part in all the educational phenomena before, during and after the first World War. The period closes as World War II is thrust upon us.

This time the war is not "to make the world safe for democracy," but to keep democracy from being crushed against the wall at its back. After the first world war came the collapse of European credits and subsequently a variety of social revolutions that have ended in ruthless dictatorships. The state-supported Continental universities were first impoverished, then regulated and finally regimented or liquidated. Because of declining financial aid, teaching and research in botany have been possible only to men of independent means, and in many of the Continental

[1] Address of the retiring president of the Botanical Society of America, delivered at Dallas, Texas, on December 29, 1941.

universities both these pursuits seem to have almost disappeared.

In post-war America, war inflation and war profiteering brought immediate hardships to college teachers during the early twenties. The late twenties brought a period of illusory expansion and easy money. Wild mergers and speculation failed to produce the then promised "new era." Rather it culminated in the bank holiday and the long depression of the thirties.

During this interval shrinkage of endowments and reduction of direct contributions threatened the very existence of many colleges and curtailed the programs of most institutions. In certain colleges only the devotion of the instructors and their willingness to continue on a subsistence basis prevented the closing of college doors. Even to-day these colleges have not fully recovered.

To relieve the widespread unemployment and the sorry plight of agriculture our national government then instituted a far-reaching program of social and economic experiments with the definite objective of increasing the purchasing power of the lower income groups. These included: Old age pensions; unemployment insurance; flood control measures; CCC camps; construction of rural subsistence communities; pegging the prices of farm products; farm loans; resettlement of farmers; forest and soil conservation; community planning, and game management. These projects have affected every rural and urban community, and the supervision of them has provided an ever-increasing number of jobs for engineers, agricultural and economic experts, foresters, zoologists and botanists. These projects have been financed in part through large internal loans.

Long before we have had an opportunity to evaluate the results and consequences of these experiments we have been plunged into World War II and we have determined to free the world of Hitlerism at any cost. In the last conflict we spent the equivalent of the present valuation of all taxable property in the United States west of the Mississippi River. Federal expenditures for the year just closing are not less than this sum, and the estimates for 1942 are more than twice this amount. The necessity for these military expenditures can not be questioned, but we should clearly realize the effects they will have on college and university resources. With this background in mind let us also try to picture what has happened in our own professional sphere and what may happen in the near future.

At the turn of the century botanical instruction in America was the natural outgrowth of the experiences of American students who had studied in various European laboratories, especially in Germany. The points of view and the techniques of instruction and research were importations direct, or indirect, hallowed by an aura of Old World traditions. Some of these foreign-trained professors, their associates and many of their students soon inaugurated new lines of research and, utilizing every new discovery in chemistry, physics and mathematics, have made American institutions outstanding in their contributions to both the pure and the applied phases of botany.

Certain of the foreign trained men of the early 1900's acquired a feeling that they must avoid problems that have immediate practical use, or are of direct social importance. This attitude was expressed by one of these men, allegedly quoting Pfeffer, "that he would leave the practical problems for the lesser minds." To him the study of a plant inside a Wardian case or in a dark room might yield information of great scientific significance; but a plant growing in a farm field or in the wild could yield little or nothing of importance. He thought it praiseworthy to cultivate and identify fungi on petri plates in a laboratory, but to study these fungi with the purpose of controlling the diseases produced by them was an occupation for those who dared not venture on the more difficult roads of pure botany.

This attitude was not confined to botanists, for I recall discussions about the same time concerning the eligibility of certain Sigma Xi candidates. These were at times acrimonious and centered about the propriety of electing to membership men who were primarily engaged in the applied (or impure) phases of science. I mention these incidents not by way of criticism, but merely as a fact to which I shall again refer farther along.

It must be perfectly evident, in this present period of rapidly changing emphasis and objectives, that the continued support of our departments of botany is dependent upon the contributions we can make by way of instruction and research to the welfare and standing of the institutions in which we work. The institutions in turn are dependent directly and unequivocally upon the services they seem to render to their students and their supporters.

During these four decades educational institutions have grown in resources and in student populations far beyond the hopes expressed by their most optimistic administrators. In 1900 there were about 168,000 students in all our colleges. By 1930 the number had passed the million mark, and by 1939 there were one million, four hundred thousand regular students and 430,000 summer school students or, roughly, more than ten times as many as in 1900. Enrolments in federally aided vocational schools of agriculture rose from 31,000 in 1920 to 539,000 in 1939, a seventeenfold increase in twenty years.

About the beginning of the century there was an average of 11 doctorates in botany conferred each year in the United States. The average to-day is around 110, just ten times as many. A majority of the degrees were, at the beginning, conferred by six institutions; to-day they are being conferred by at least 66 institutions, and the larger departments are granting from 5 to 16 in a single year. In addition, there are now given each year from 20 to 30 degrees that, if one may judge by the titles of the theses, are based on the results of pure botanical research conducted by departments of horticulture, forestry and agronomy.

Forty years ago the quarters occupied by botany departments were certainly not comparable to those occupied by the other fundamental science departments of the same institutions. The old saw that "a stranger can easily locate the botany department by looking for the poorest building on the campus" appeared in SCIENCE and in other periodicals of that time. This is in striking contrast to the modern fireproof buildings and greenhouse facilities in which many departments are housed to-day. In the matter of optical, physical and chemical equipment the departments in our larger institutions and in those associated with the agricultural colleges are now certainly comparable to those of other science departments in the same institutions.

At the time of the organization of the present Botanical Society of America in 1906 there were 116 members; to-day its membership numbers 1,360, of whom 840 are primarily engaged in teaching. In addition, the allied botanical societies list 1,125 plant pathologists, 625 plant physiologists, 500 plant taxonomists, 400 mycologists and 275 bryologists, not to mention botanical memberships in ecological, horticultural and agronomic societies.

The first edition of "American Men of Science" (1906) listed 169 botanists, while the sixth edition (1938) listed 1,677. This list indicates that not only have many doctorates been conferred each year, but it has been possible for the new doctors to find teaching positions in colleges, teachers colleges and universities; and research positions in agricultural experiment stations, private research institutions, land survey offices, game management programs and in forest and soil conservation projects.

Expansion within the fields of agricultural research and of conservation of land and water resources has been even greater than that in the colleges. If you have tramped the eleven miles of corridors in the Department of Agriculture building at Washington and visited the outlying structures at Beltsville, or attempted to contact men in the fourteen scattered buildings that house the Conservation Department you will know what I mean. These Washington offices merely house the centers of stimulation and control of thousands of field men operating in every part of the United States. Indeed, any district in the United States in which there is neither a minor nor a major project of this kind in operation is either unpopulated or very poorly represented in Washington. The government probably has never expended money that added more to our national wealth, health and happiness than the projects fostered by these agencies. In the matter of personnel, these enterprises have been a godsend to many a graduate student and poorly paid instructor of botany.

The latest summary (1938) of the annual resources of American colleges and universities shows that 30 per cent. of their incomes is derived from miscellaneous gifts, collections, sales and auxiliary enterprises, 28 per cent. from student fees, 26 per cent. from state and local government appropriations, 4 per cent. from the Federal Government and only 2 per cent. from endowments. This seems to indicate that 94 per cent. of the financial support received by the average college or university comes directly from the students and from the public that lives at no great distance from the institution. Since in the past the curve of college philanthropies and public support has paralleled the curve of general prosperity, this appears to be a most appropriate time for careful planning, not only by institutions, but by departments and by societies interested in graduate education and research. Will it be possible to continue to secure adequate local and institutional support during the coming years while the Federal Government is trying to prevent the accumulation of surplus funds by those citizens whose incomes are above the subsistence level? This group includes the forty million salaried persons, whose incomes are relatively stable and who probably contribute most to the financial support of collegiate instruction. According to the Brookings Institution the purchasing power of this salaried group in 1942 will be reduced about 25 per cent. below that of the present year.

Most graduate students in our institutions are partly or wholly supported through scholarships, fellowships and assistantships. Since there are usually five to ten applicants for every vacancy it has been possible to select a superior group of fellows and assistants. In those institutions in which such men and women are working as assistants in teaching or in research, the maintenance of these awards has not been a wholly philanthropic procedure. Some of these assistants, on the theory that they learn by doing, have labored as much as forty hours a week, and then pursued their graduate studies in their remaining leisure hours. Graduate assistants have been benefac-

tors to many poorly supported departments and to many a professor who felt that he was overworked or that he should not be bothered with laboratory instruction. Under these circumstances, the holders of assistantships have paid and often overpaid their way through graduate schools. Young men have been willing to serve these apprenticeships either because of their "satiable curiosity" or because of the promise of positions for which the Ph.D. degree is a prerequisite.

These are some of the outstanding facts concerning the forty years of expansion that may well constitute the *Golden Age of Botany*. Briefly, they indicate that the ten-fold increase in college enrolments, the more recent seventeen-fold increase in federally aided vocational schools and the enormous spread of agricultural and land-use programs have made possible the growth of graduate study in botany. Altogether, about 2,000 doctorates have been conferred during the period, and these doctors have found remunerative positions. We may well take pride in this accomplishment and in the results of the researches to which these men have contributed. But we should also be apprehensive of certain social and educational movements that may materially alter this picture.

The curve of growth eventually flattens, whether it represents the growth of plants, of populations or of post-doctorate positions. It has been a heartening and interesting experience selecting and promoting men during the upward swing of botanical prosperity. Will it be equally thrilling to plan for a change in the direction of the curve?

If I read correctly the handwriting on the federal wall, we in botany are rapidly approaching a plateau of post-doctorate employment. Under these circumstances, are we justified in continuing to encourage so many young men and women to spend four or five graduate years preparing for positions that may not exist?

We know now that the curtailment of most non-defense federal and state projects has begun. We may be pretty sure that college and university incomes will be somewhat less. We can likewise forecast that some of the men now working on so-called emergency projects will be looking for positions in permanent educational and research institutions. The availability of these men will not enhance the chances of employment for inexperienced young doctors.

Some educators predict a great post-war expansion of educational facilities by the Federal Government in the form of vocational schools. Some of my botanical friends have suggested that the larger high schools and vocational schools will absorb the botanical doctors for many years to come.

In this connection we must not be blind to the fact that the administration of these secondary schools is now almost completely in the control of professional educators, very few of whom have had training in the sciences. Most of them have a background of educational philosophies that have been developed neither through valid experimentation nor by scientific methods. Their procedures are based on the inferences of doctrinaires who have theorized about education for "the good life" or for "social welfare."

Field observation of these educators in action suggests that many of them still regard science courses as informative exercises. They overlook the most important contribution that science instruction can make, namely, training in the recognition of relevant data, prolonged student experience in the drawing of correct inferences from such data and the substitution of scientific procedure in thinking for wishful cerebration.

Many professional educators have even less confidence in the study of the subdivisions of science as a contribution to "the good life" and to the salvaging of mankind. Like many lay critics of present-day educational programs they neither understand the objectives of science instruction, nor grasp the fact that however thick the veneer of classical and ethical philosophy has been applied to a hundred generations of men, the gene complements of human beings remain very much the same. Sour apples and sweet alike have been nourished on sugar.

These educators have not been satisfied with the kinds of courses offered either by zoologists or botanists when these courses consisted of learning the names of microscopic structures, their alleged functions and the Darwinian proofs of evolution. They wanted something more directly related to the lives of the students and to community welfare. Their prayer was first answered by various zoologists who offered unit courses and wrote text-books of biology. One of the reasons why many schools adopted biology was that the biology books chose to present a variety of units of popular appeal. They emphasized food and energy, personal hygiene, sanitation, familiar plants and animals, interdependence of organisms, conservation and the relation of each of these topics to human affairs. Many of these unit courses were informative, but they were more in the nature of propaganda than of science. Since they served to acquaint students with a variety of pertinent biological questions and answers, school administrators seized upon them as a way to replace the former evolutionary courses of botany and zoology.

In these biological catechisms the botanical units were usually very sketchy and occupied only a fourth or a fifth of the books. The principal emphasis was placed on animal biology because these units formed a basis for the further study of human anatomy and

physiology. They were also better adapted to be taught part time by the athletic coaches. Where these biology courses went into the schools, botany came out, and only the larger schools provided a supplementary course in plant science. Because of the relation of biology and zoology to medicine, many of the smaller colleges find it profitable to offer premedical curricula, and here again instruction in botany appears to be a luxury.

Because of the demand for biology teachers, colleges of education have asked that biology courses supplant the more specialized botany and zoology courses. In part this is a method of cutting down on the time allotted to subject-matter studies; in part it is a method of providing the student with a ready-made pattern of biology instruction at the college level, that he can apply immediately and with little effort in the sphere of the secondary school. Educators assume that plants and animals are so similar in physiological processes, cell structures, essentials of reproduction and heredity that they can not see why we should insist on dividing the instruction into two "compartments." The answer is too obvious to be discussed here.

Survey courses afford another economical means of imparting science information to large groups of students. They bear the same relation to laboratory and field botany courses that seeing the movies of football games bears to participation in the game. They may stimulate interest in science, but the students can not acquire the habit of scientific thinking by these methods any more than they can acquire the techniques of playing football by looking at the movies.

In times of financial stress, however, administrators sometimes decide upon course offerings without benefit of consultation. Arts colleges, as in the past, may grasp the straw of premedical studies and drop all botanical instruction. Teachers' colleges that insist on the teaching of biology followed by supplementary courses on birds, insects and human physiology will find zoologists far more useful than botanists.

Granting that there do exist secondary schools in which some of the teachers have doctor's degrees, many educators are at the present time definitely opposed to the employment of teachers who have specialized to this extent, unless perchance the degree was conferred for studies in the teaching of biology. One state administrator made this clear when he said that science Ph.D.'s should be kept out of secondary schools because their training had made them interested in science rather than in the education of boys and girls. This attitude may be radically changed, however, when most of our superintendents and principals themselves are ornamented with doctor's degrees.

Retirement funds and pensions were lauded at the time when private foundations and state governments established them. Pensions were supposed to encourage teachers to devote their lives to instruction in spite of the comparatively low salaries. In general this effect has been attained. However, there is a demon in every benign formula. College administrators whose institutions were contributing to these funds soon began to study the actuarial tables to see how much of their incomes would be absorbed by the promised pensions. Some institutions found that they were harboring too many men approaching the retirement age. If there seemed to be no way to enlarge their budgets the institutions have two other ways to meet the actuarial situation. One is to encourage older men to leave when they receive an offer elsewhere, and replace them with beginners; the other is to limit all new appointments to young men.

This procedure will literally put numerous competent, but older men on the spot if they should lose the positions they now hold. None of these colleges now wishes to increase its liabilities when it can decrease them by hiring beginners at subsistence salaries. In general, these beginners can be most easily recruited from those of their own recent graduates who have not secured positions elsewhere and this leads to servile inbreeding. Prospective pensions also have been factors in the release of older faculty men, regardless of their health and competence on various flimsy pretexts, and the substitution of young men. Pensions seem to favor the young doctors.

Returning now to the so-called "lesser minds," or to those men who have always been interested in the applications of botany to agriculture, horticulture, forestry and conservation—these are the socially minded botanists, and the results of their work are apparent everywhere. They have made it possible for two blades of grass to grow where none grew before, and they have transformed the practices in every art related to plant growth. They have enriched us with fruits, grains, vegetables and ornamentals from other continents; they have provided us with new and better varieties; they have discovered methods of preventing or controlling parasitic devastations, and they have found new ways to augment the growth of plants and increase the returns from the land.

One of the results of the cooperation of the "lesser minds" with the agricultural and conservation interests, with the various grower's associations and with the public, has been an increasing demand for the support and continuation of their own research projects. A second result has been that they have fur-

nished the only basis for the continuation of research by the esoteric botanists who looked askance at them not so many years ago. How large an audience and what kind of equipment would these academic botanists have to-day were it not for the cooperation of the botanists in the public service and the enthusiasm they have transmitted to young men looking for a career?

Another consequence of the activities of the "lesser minds" has been the securing of funds for experimentation and research on a scale never dreamed of by the older botanists. They have become the principal source of information about the growth of plants out-of-doors. They have transformed the old indoor botany, with its "bean, pea and popcorn" demonstrations in Wardian cases, into a science of plants as they grow in fields and orchards, as well as in forests, grasslands and deserts. At the same time, they have probably contributed as much to botanical theory as have the occupants of the ivory tower.

I have briefly sketched some of the changes in point of view that have occurred during the past four decades, and I have pointed to some of the dangers that attend the impending overproduction of doctors in the field of botany. The present year-to-year increase must sooner or later lead to many personal catastrophes.

We the members of the Botanical Society constitute the only group that can anticipate and ameliorate this situation. By mutual cooperation we can suggest more intelligent preparation for graduate study of botany, and we can insist on a higher and a broader foundation for admission to candidacy for the Ph.D. degree. By this method alone we can also gradually adjust the number of graduate assistants and fellows to the number that can secure permanent appointments upon graduation.

If, in the near future, an outlet for our doctors develops in the secondary schools we should be prepared to certify that every doctor can not only meet the State Board requirements, but that he has a background in the allied sciences that will enable him to visualize the field of plant science as a whole and that his perspective is not limited to the narrow confines of his research interest.

All that I have said up to this point was written a month ago before we became active participants in the life-and-death struggle between Hitlerism and Democracy. The future is even more complicated than it was a month ago. The implications of an all-out war further emphasize the need for a new qualitative and quantitative appraisal of our procedures both in the field of graduate studies and in the enlistment of continued public support through the education of undergraduate students.

In the face of the sacrifices of our young men, the dissipation of our natural resources and the threat to all our ideals of "life, liberty, and the pursuit of happiness," the future of our profession may seem trivial and irrelevant. Nevertheless, there will be an end to this war just as surely as there was a beginning, and now is the time to plan for the aftermath.

EVOLUTION AND KNOWLEDGE

By Professor WILLIAM E. RITTER

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I AM incited to the following remarks by the difference, concerning the evolution theory, between R. Goldschmidt and F. B. Sumner as manifest by Sumner's recent article "Is Evolution Inscrutable."[1] These zoologists are fellow colleagues of mine (or would be if I were not a mere emeritus) in the University of California, and both have my high esteem, personal and scientific. And I make the remarks with less hesitation in that I do not pretend to mediate the seeming difference between them.

If we biologists—especially the zoologists among us—look at ourselves closely, it strikes me that most, if not all of us, would see that we have steered a rather queer intellectual course relative to the evolution problem since Darwin gained, for the general theory of it, acceptance by almost every student well grounded in the fields of research in which it chiefly lies.

And perhaps the queerest, if not the most unfortunate, thing about it is that so much of our procedure has reversed the order, so far as knowledge is concerned, followed by Darwin in working out the theory.

It would seem quite uncalled for to remind any educated person to-day of the origin of the theory from Darwin's experiences as the naturalist of the famous *Beagle* voyage. But there are aspects of his experiences, as an observer of the vast and varied phenomena he came upon, that call for a sort of attention that they get all too little of, even by many of the most highly educated persons.

For instance, I was rather shocked lately by being called down quite emphatically in a group of natural scientists, for quoting Darwin's well-known statement that he worked on true Baconian principles and "without any theory collected facts on a whole scale."[2]

[1] SCIENCE, May 30, 1941.

[2] "Life and Letters," I, p. 68.

Although the subject was touched only incidentally, the essence of the group's view seemed to be that no real scientist ever begins a real research without a theory of some sort as a starter.

Yes, I am now convinced by my later, more thorough reexamination of Darwin's attitude toward nature and his methods of research that he was entirely right in what he said about his procedure that led him not only to his general theory, but to all his special hypotheses in connection with it.

A secondary but yet important thing here is the naiveté, the literally child-like confidence the man (like nearly all persons eagerly devoted to the study of nature) had in thoroughly verified sense perceptual knowledge of the phenomena under investigation.

Could anybody be so egregiously foolish as to contend that Darwin did not see, that is, observe by the sense of sight, the various fossils he came upon in South America *before* he guessed, that is, made hypotheses, that they were once parts of creatures that lived long ago; and that those creatures might be the ancestors of creatures he had observed as present-day inhabitants of the region?

And recall the extent of observational study he had to make on the birds, especially of the Galapagos Islands, before he could theorize about their kinship with birds of the rather distant South American continent.

A particularly crucial factor comes into the situation with the endlessly debatable idea of "cause." For the evolution problem, the fact of "variation" was a poser for Darwin as it has been for every one else who has observed widely and thought earnestly on the nature and origin of the kinds or species of plants and animals. And the great figure the facts cut in Darwin's theory is too familiar to need dwelling on. The cardinal point for us here is that Darwin just took the facts of variation as observed by him and innumerable other trustworthy naturalists. Regardless of the cause or causes that produced variations, *there they are,* he said in substance over and over again, *amply verified and readily verifiable by observation.*

Not by any means was he disregardful of the problem of their causes. But so innately certain was he of the necessity of their being established as observed facts before the question of their cause or causes could even be asked, that he justifiably saw no reason why they should not enter as factors into a general theory of the origin of species while yet the causal question of the variations was still under investigation.

For one thing, the very idea of such a thing in living nature as "species" Darwin knew, as do all other persons thoroughly devoted to the study of this portion of nature who are usually classed as "naturalists," rests at bottom on sense perceptually acquired facts about the make-up of this portion of nature.

So the problem of the cause or causes of variation would be only a part of the larger problem of the cause or causes not only of species, but also of the existence of living nature.

I find nothing in Darwin's writings that seems to me more convincing of his faith (I do not think this word is too strong) in the reality of nature generally, and in the basic role of sense perception for gaining knowledge and understanding of that reality, than in one of his letters to Asa Gray. The sentence that appears to me crucial, but to have received too little attention, is this: "Personally, of course, I care much about Natural Selection; but that seems to me utterly unimportant, compared to the question of Creation or Modification."[3]

Read in the light of all his work this is only another, and a bit more the crucial, way of saying that as opposed to the doctrine or theory of a *supernatural* cause of living nature with its maze of different kinds of individuals, Natural Selection as a causal theory of it is "utterly unimportant" as compared with a theory that *natural* causes of some sort have produced the modifications, and changes of kinds into other kinds as they are presented for sensory observation in endless profusion.

But it was only when Darwin came to deal specifically with the nature of man in the light of the general theory of evolution, that his faith in, and reliance on, such observation becomes manifest in all its concreteness and depth. Here it is most fully displayed in "The Expression of the Emotions in Man and Animals." For here he undertook his most systematic and thorough-going comparison of man with his closest subhuman mammals on the basis of one attribute (the "emotions") common to both. One thing about this research is particularly significant for these remarks. That is its example of one aspect of what research in "natural history" included for Darwin, when applied to man. This is indicated, for one thing, by his making the problem of "causes" strictly subordinate to, and dependent on, facts of observation. Thus, after speaking about various difficulties encountered in such a research as he was here entering upon; and mentioning "the observation of infants" as one means of overcoming the difficulties, he writes: "But there remains the much greater difficulty of understanding the cause or origin of the several expressions and of judging whether any theoretical explanation is trustworthy" (p. 20).

Considerably more of the paragraph in which this

[3] "Life and Letters," II, p. 163.

occurs is much to our point—but we pass it. A particularly significant thing in connection with the causal question is the little reference to natural selection in the whole book. The term has no place in the index.

Another sharp indication of the place evolution, as compared with natural selection, had in Darwin's thought is given us on the same page as the above quotation. "With respect to my own observations," he says, "I may state that they were commenced in the year 1838. . . . At the above date, I was already inclined to believe in the principle of evolution, or of the derivation of species from other and lower forms."

No one should need to be told that the "above date" was many years before the hypothesis of natural selection had entered his mind.

But Darwin's faithfulness to sensory observation as an essential preliminary to all theory about evolution, finds its most crucial illustration at a specially recondite point in "The Descent of Man." This we shall notice presently. But it seems desirable to glance at one or two simpler illustrations, prefacing the glance, by noting that the procedure in the entire book is really illustrative of the principle. Having reached the general theory as to living nature, his purpose here is to consider whether the observational facts of the particular species, man, are such as to justify the theory that he too originated as species in general almost certainly have originated—and are still originating.

The whole of Part I is devoted to evidence available from observational studies of man as he exists now or has existed in the recorded past, that which agrees with the observational evidence basic to the general theory of evolution, especially as applied to the higher portions of the animal world. That is to say, it is not a theory of man's origin at some remote time in the past that Darwin starts with, but an extensive presentation of observed facts of what he is at present.

Thus notice some of the items listed in the first chapter of the first part: "Nature of the evidence bearing on the origin of man; Homologous structures in man and the lower animals . . . muscles, sense-organs, hair, bones, reproductive organs, etc." These are such commonplace matters that to one absorbed in the great philosophic problems of man's nature and origin they may seem too trivial to deserve serious attention.

Accordingly we pass to the "specially recondite point" referred to above—with the reminder that it occurs in the same Part I of the book. That is to say, for Darwin it belonged to the same category of sensory observational knowledge as the trivial stuff quoted above. The point is in Chapter IV, which starts off with the discussion of "The moral sense." "'This sense,' as Mackintosh remarks, 'has a rightful supremacy over every other principle of human action.'" Then follows immediately the "recondite point" referred to. It contains Darwin's own statement of what the supreme "principle of human action" is: "It is summed up in that short but imperious word ought, so full of high significance. It is the most noble of all the attributes of man, leading him without a moment's hesitation to risk his life for that of a fellow creature; or after due deliberation, impelled simply by the deep feeling of right or duty, to sacrifice it in some great cause."[4]

It would have been well had Darwin cited a few well-known observed and recorded examples of the applications of the "imperious word"; and of the sacrifice of one's life in "some great cause." But it probably did not occur to him that any of his readers would question either the recognition of the imperiousness of the *"ought"* or the "deep feeling of right or duty"; or of the knowledge of these having been reached in part through sense-perceptual experiences.

However, had he gone into the matter more specifically, more analytically, he might have clarified his conception that the "most noble of all the attributes of man" belong to him as a product of natural evolution and hence are subjects to be studied and understood by the method of "Natural History"—by the methods, that is to say, the initial steps in which are sensory observations.

In the very same paragraph with these statements we read:

> Immanuel Kant exclaims, "Duty! Wondrous thought, that workest neither by fond insinuation, flattery, nor by any threat, but merely by holding up thy naked law in the soul, and so extorting for thyself always reverence, if not obedience; before whom all appetites are dumb, however secretly they rebel; whence thy original?"

It is noteworthy that Darwin quotes this from the "Metaphysics of Ethics" (translated by J. W. Semple, Edinburgh, 1836, p. 136.)

A comprehensive study of "The Descent" and the "Expression of the Emotions" leaves not a scintilla of doubt—with me at least—that as Darwin wrote this his own answer ("Evolution" as he conceived it) to Kant's "whence thy original?" was in the back of his mind.

But momentous as this is in its implications it is not what specially concerns us here. Our main concern is the knowledge problem involved. This leads us to words in the next paragraph of the same chapter. After speaking almost apologetically of why he felt he could not avoid touching the great problem of

[4] "Descent," 2nd ed., p. 148.

morals, he tells us: "As far as I know, no one has approached it exclusively from the side of natural history."

Here we have a striking example of what may well be called Darwin's naiveté. In pitting his natural history method against the *a priori* method employed by Kant in his doctrine of the categorical imperative as an interpretation of the "imperious word ought," and of "Duty! wondrous thought," Darwin seems to have realized very dimly if at all that he was running head-on into one of the worst tangles of logic as a subject for general treatment. The tangle referred to is that of the relation between the two portions of logic known as inductive and deductive. More specifically stated, it is the relation between sense perception and observation on the one hand, and reason and thought in all their vast scope and power on the other hand. Darwin seemingly felt perfectly certain of the essentiality of both—of their inseparableness at bottom—for getting knowledge by the methods of natural history as he conceived and practiced those methods in all his work. Hence it apparently did not occur to him that anybody would be confused by his approach to the moral problem including the idea of "Duty! wondrous thought," as he was now approaching it.

But the more acquainted I become with the flood of discussion, by friends and enemies of the Darwinian theory of evolution, the more I am impressed by the extent of the confusion, even contemptuous hostility, on this very matter.

I am now convinced that in probably no other connection, in all Darwin said about evolution, is there more to justify the recent conclusion reached by a few students and pungently expressed by Sir Arthur Keith, that even the best of biologists and historians have not yet accepted evolution "beyond their lips."

It may possibly add something to this view if I say that my own efforts during the last decade or more to understand the human species in the entire scope, physical, mental and spiritual, of its nature, had led me to essentially the same conclusion before I came upon Sir Arthur's statement.

It now seems to me impossible for anybody whose technical training and general experience enables him to grasp what Darwin meant by, and included in, natural history, to fail, after a thoroughgoing study of Part I of "The Descent" and the whole of "Expression of the Emotions," to recognize the full justification of Darwin's confidence in both the inductive and deductive sides of logic as defined above.

As something of an indication of his fidelity to reason, thought and the rest of what the deductive side of logic chiefly depends upon, notice the list of topics treated in Chapter III of Part I: "The difference in mental powers between the highest apes and the lowest savage, immense—Certain instincts in common—The emotions—Curiosity—Imitation—Attention—Memory—Imagination—Reason—Progressive improvement—Tools and weapons used by animals—Abstraction, Self-consciousness—Language—Sense of Beauty—Belief in God, spiritual agencies, superstitions."

This list of topics and the fifty-page discussion of them should, of course, be read not as though written by a full-fledged psychologist or philosopher of to-day, but by a full-fledged naturalist of more than three quarters of a century ago.

This list shall serve to bring these "remarks" of mine—already run far beyond what I expected—close to an end. The crux of the remarks that I've been trying to reach all the while is this: Although Darwin says nothing of the sort expressly, the implications of much that he says are unmistakable (to me at least) that the problem of knowledge itself would be for him part-and-parcel of the problem of evolution. The much-used phrase "natural knowledge" would not for him have the usual limited meaning of knowledge of external, sense-perceptual nature, but would include knowledge of knowledge itself as one aspect of the grand sweep of nature in its unified wholeness. Then since the theory of evolution is a product of, and is embedded in, natural knowledge; and this as a whole is produced by men and is constantly being reproduced, revised, and improved by the observations and reasonings of men actually living at any given time, this very year for instance, no causal or other factors of the evolutionary process can rightfully be conceived as lying outside the scope of nature. That this is true Darwinism, not only as to Evolution but as to nature in general, I trust my sketchy remarks have made to appear highly probable at least, to my readers.

Finally as to the relevancy of such a view to the issue between Goldschmidt and Sumner: Sumner's solicitude expressed in the last sentence of his article lest Goldschmidt is leaving "naturalistic biology in a most embarrassing position" does not disturb me nor, I think, any adequately understanding Darwinian. This is so because nothing in the framework of a naturalistically conceived biology can rightly be conceived otherwise than as naturalistic. The Darwinian theory of evolution is only one aspect or phase of the Darwinian theory of the all-inclusiveness and all-adequacy of nature.

Goldschmidt's causal theory of evolution must, of course, according to the standpoint of these remarks, be brought to the bar of natural knowledge as defined above—just as is the case with any other such theory.

OBITUARY

ALEXANDER LOWY
1889-1941

DR. ALEXANDER LOWY, professor of organic chemistry in the University of Pittsburgh, died in The Western Pennsylvania Hospital on December 25, 1941, after an illness of about four months.

Dr. Lowy was born in New York City on March 31, 1889, the son of David and Fanny (Weiss) Lowy. He obtained his bachelor of science degree from Columbia University in 1911, the master of arts in 1912 and the doctor of philosophy degree in 1915. His major work was in the field of organic chemistry under Columbia's Professor Marston T. Bogert, leader in the field of organic chemistry and president of the International Union of Chemistry. On December 23, 1915, he married Dora Landberg of Brooklyn.

Dr. Lowy was assistant in electrochemistry in Columbia University from 1912–1915. He taught in the high schools of New York City from 1915–1918 when he became professor of organic chemistry in the University of Pittsburgh with which he was associated until the time of his death. During the past summer he was exchange professor in the University of Southern California. Dr. Lowy was the holder of numerous United States patents. He was a recognized authority in the field of protective chemicals, having invented methods for the safeguarding of banks and vaults. He also made important contributions in the field of dyestuffs and was a pioneer in electro-organic chemistry, to which he contributed numerous researches. Dr. Lowy, with Dr. Benjamin Harrow, of the College of the City of New York, was the author of *A Textbook of Organic Chemistry,* which is in use in over 125 colleges and universities in America. This textbook has gone through many revisions. Each revision included the latest developments in the field of organic chemistry and the most modern charts and devices. This tendency was characteristic of the senior author. A companion volume to the text-book is *A Laboratory Manual of Organic Chemistry* with Dr. Wilmer E. Baldwin, assistant professor of chemistry in the University of Pittsburgh. This also has had extensive adoptions. Dr. Lowy contributed the chapter on organic chemistry to Rogers's *Manual of Industrial Chemistry.* Alone and with his research students he was the author of over seventy research reports and scientific papers which have appeared in technical journals since 1919. Dr. Lowy was a member of the American Chemical Society and a past chairman of the Pittsburgh section. He was a member of the American Electrochemical Society and its vice-president from 1930–1933 and again from 1939–1941. He was chairman of the committee on publications of this society from 1931 to 1941. He belonged to the honorary science societies, Sigma Xi and Phi Lambda Upsilon. He was an honorary member of Sigma Alpha Mu fraternity.

In the summer of 1929, Dr. and Mrs. Lowy visited England and continental Europe, where Dr. Lowy made a study of the universities and industrial establishments. He lectured extensively and addressed many of the sections of the American Chemical Society. It was as a teacher that Dr. Lowy reached his pinnacle. No effort was too great to provide what was best for the student. The painstaking care with which material was presented left no question regarding accuracy. He was exacting in the student's performance, but at the same time tolerant of the individual's difficulties and ever willing to lend the student a hand and help him, not only in his studies but in his private problems. Dr. Lowy had no hobbies. His only pleasure was his work except during recent years when he enjoyed his small farm in Gibsonia, Pennsylvania, where he and his family spent the summers. In the University of Pittsburgh he was a member of important committees and was faculty chairman of registration.

ALEXANDER SILVERMAN
UNIVERSITY OF PITTSBURGH

ORIN F. STAFFORD

ORIN F. STAFFORD, chairman of the Chemistry Department of the University of Oregon and dean of science and of the Lower Division, died at Eugene, Oregon, on September 17, 1941, after a painful illness of two months.

Professor Stafford was born at Hillsboro, Ohio, on February 7, 1873. He moved with his parents to Kansas in 1885, and in 1900 received the A.B. degree from the University of Kansas and in 1902 the A.M. degree. In 1900 he was appointed instructor in chemistry at the University of Oregon. In 1902 he became assistant professor and in 1906 was promoted to full professor and head of the department. He became dean of science in 1934.

While at Kansas Stafford was assistant to Dr. E. C. Franklin and participated in the pioneer work on solutions in liquid ammonia. Thus began an intimate friendship between the two men which continued throughout subsequent years.

Professor and Mrs. Stafford spent the year 1908–09 in Europe, where he did graduate work at the University of Berlin under Dr. Walter Nernst. During the four years from 1918 to 1922 he was on leave of absence in Boston and Kingsport, Tenn., developing his invention for the autogenous distillation of wood.

This invention and subsequent work on the subject of wood waste brought him wide recognition as an authority on wood distillation and waste wood utilization and, up to the time of his illness, he carried on an extensive correspondence concerning the problems involved in this interesting field.

He was active as a member of scientific organizations. He rarely missed meetings of the local chapter of the American Chemical Society. He served as president of the Oregon section and as its representative as councilor of the national society. He was president of the Oregon chapter of the Sigma Xi and was prominent in the councils of the local chapter of Phi Beta Kappa. He was a member of the program committee of the Pacific Coast Division of the American Association for the Advancement of Science. At the time of his death he was one of the inspectors for the committee of the American Chemical Society for accrediting institutions for the training of chemists. He was also the chemistry representative on the basic science examining committee for licensing physicians in the State of Oregon. Locally he was president of the Eugene Rotary Club, a member of the Round Table Club, a member of the Eugene School Board and one-time president of the Boy Scout Council.

Though he was not formally trained as an engineer he possessed the instincts of one and was always interested in chemical engineering problems. The practical more than the purely theoretical implications of chemical discovery always intrigued him. However, in spite of his scientific, academic and community activities his primary concern was always the interest of his students. He was a patient, thorough and painstaking teacher. He would lay aside any task to answer the appeal for help from any struggling student. In return he was accorded not only the respect of his students but their lifelong friendship as well. Professor Stafford's contributions to the literature of chemistry, while not particularly voluminous, were valuable and substantial and reflect the breadth of his interests, ranging as they did from the mineral resources of Oregon and the composition of the saline lake deposits to the molecular weight of sulfur and solubilities in acetamide.

He held memberships in the following societies: American Association of University Professors, Phi Beta Kappa, Sigma Xi, American Institute of Chemical Engineers, American Chemical Society, and he was a fellow in the American Association for the Advancement of Science.

His hobby was flowers and shrubs. He spent early morning and evening hours in his garden. After the onset of his last illness he officially retired from active duties and was looking forward to recovery and freedom to more fully enjoy his outdoor activities.

Professor Stafford leaves his wife, Mary Elizabeth Stafford, daughter of the late Dean John Straub; his two sons, both of whom are married and reside in Eugene, Howard Straub Stafford and John Edward Stafford; one daughter, Miriam Stafford Hamilton, of Wenonah, N. J., and one grandson, Robert Stafford Hamilton.

F. L. SHINN

EUGENE, OREGON

RECENT DEATHS

DR. HEBER DOUST CURTIS, head of the department of astronomy at the University of Michigan and director of the observatory, died on January 8 at the age of sixty-nine years.

STEWART PATON, consultant in mental hygiene and lecturer in psychiatry at the Johns Hopkins University, died on January 7 at the age of seventy-six years.

Nature records the death of Dr. H. Ettringham, president of the Royal Entomological Society in 1931–1932, on November 26, at the age of sixty-eight years; of Dr. Walcot Gibson, formerly director for Scotland of the Geological Survey of Great Britain, on November 28 at the age of seventy-seven years; and of Dr. F. Stang, from 1921 to 1927 rector of the University of Oslo and president of the Nobel Committee of the Storting, who was known for pioneer work in comparative research in human culture, at the age of seventy-four years.

SCIENTIFIC EVENTS

WAR WORK OF THE CANADIAN RESEARCH COUNCIL

ACCORDING to the official report, scientific research in Canada since the war began has been directed almost wholly to the solution of new and urgent problems arising out of the war. Dr. C. J. Mackenzie, acting president of the National Research Council, points out that the council, the universities, members of the scientific and engineering professions and the technical staffs of industrial firms are pulling together towards the common goal, united as never before in the single purpose of winning the war.

In the National Research laboratories at Ottawa work has been expanded in several directions because of the war. In the chemistry and biology divisions especially the selection and testing of suitable materials for the use of the armed forces has been a major problem. Specifications for materials normally bought

in England have had to be revised to conform with Canadian practice. All kinds of supplies have had to be tested to determine whether they are acceptable according to required standards. Technical advice has been given as requested by the services in the specialized fields of science in which the council members are trained. Food storage and transport under war conditions presented many difficulties. Lack of refrigerated space and indeed lack of ocean shipping space made it necessary to devise new methods of handling perishable foodstuffs. The tremendous increase in volume of merchandise being shipped and the limited number of cargo vessels available require that the best possible use be made of every inch of space.

In physics, electrical and mechanical engineering, the design and development of new detecting devices to locate aircraft, submarines, mines and other enemy equipment have been carried forward with much success. Testing of engines, hulls, aircraft and hosts of other items of equipment used in mechanized warfare has been done on a large scale.

THE ELLA SACHS PLOTZ FOUNDATION FOR THE ADVANCEMENT OF SCIENTIFIC INVESTIGATIONS

DURING the eighteenth year of the Ella Sachs Plotz Foundation for the Advancement of Scientific Investigations, sixty-seven applications for grants were received by the trustees, forty-nine of which came from seven different countries in Europe, Asia, North and South America. The total number of grants made during this year was thirty-five, one of these being a continued annual grant. In the eighteen years of its existence the foundation has made four hundred and twenty-nine grants which have been distributed to investigators throughout the world.

For the present, researches will be favored that are directed towards the solution of problems in medicine and surgery or in branches of science bearing on medicine and surgery. Grants may be used for the purchase of apparatus and supplies that are needed for special investigations, including technical assistance, but not for providing apparatus or materials which are ordinarily a part of laboratory equipment. Stipends for the support of investigators will be granted only under exceptional circumstances. The maximum size of grants will usually be less than $500.

Applications for grants to be held during the year 1942–1943 must be in the hands of the Executive Committee before April, 1942. There are no formal application blanks, but letters asking for aid must state definitely the qualifications of the investigator, an accurate description of the research, the size of the grant requested and the specific use of the money to be expended. In their requests for aid, applicants should state whether or not they have approached other foundations for financial assistance. It is highly desirable to include letters of recommendation from the directors of the departments in which the work is to be done. Only applications complying with the above conditions will be considered.

Applications should be sent to Dr. Joseph C. Aub, Collis P. Huntington Memorial Hospital, 695 Huntington Avenue, Boston, Massachusetts.

THE NUTRITION FOUNDATION, INC.

ACCORDING to an announcement recently made by Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, fifteen leaders in the U. S. food industry are sponsoring a Nutrition Foundation to help to build American health and energy.

Dr. Compton has been elected chairman of the board of trustees of the foundation—which will be operated on a non-profit basis to distribute freely all scientific discoveries in foods and diet. The Nutrition Foundation, Inc., has been incorporated at Albany under the membership corporations law of the State of New York. The fifteen prominent manufacturers, who have contributed an operating fund amounting to hundreds of thousands of dollars for the establishment of the first cooperative scientific research laboratories created by the food manufacturing industry, are the American Can, Beechnut, California Packing, Campbell Soup, Continental Can, Corn Products, General Foods, H. J. Heinz, Libby McNeill and Libby, National Biscuit, Owens-Illinois Glass, Quaker Oats, Standard Brands, Swift and United Fruit.

The board of trustees will include officers of these companies, together with Americans prominent in government, business and national life, as well as representatives of other companies which later may join the foundation. Leaders in scientific and related fields will be invited to serve in various important capacities in the work. Dr. Compton stated that the Nutrition Foundation had been underwritten by a group of leading manufacturers in the food industry and allied fields as a needed public service. The purposes of the new organization are as follows:

(1) To develop and apply the science of nutrition in its fundamental conception and practical significance as a basic science of public health;

(2) To aid the food industry in appropriately solving its general and individual problems relating to that science; and

(3) To do so by lawful and effective means, as a public institution operated on a non-profit basis and dedicated to improve the food and diet and thus to better the health of the people of the United States of America.

THE NATIONAL FOUNDATION FOR INFANTILE PARALYSIS

THE third annual report of the National Foundation for Infantile Paralysis, containing a broad outline of the work which was sponsored by the foundation during 1941, was issued on January 12. Basil O'Connor, president of the foundation, states that the task of the National Foundation in attempting to conquer infantile paralysis and to ameliorate its effects has fallen into two main divisions: national and local. The National Foundation acts in the national field chiefly as a research grant-making, coordinating and educating agency. Its activities are divided into five divisions: virus research, nutritional research, after-effects research, epidemic aid and education. To carry out this program during the past fiscal year, $807,131.50 was spent as follows:

For virus research, grants and appropriations totaling $186,565.06 were made to universities, schools of medicine, hospitals, research foundations and state departments of health.

For studies on nutrition, $67,969.17 was granted.

For after-effects research, included in which is the work of Miss Elizabeth Kenny and fifteen other grantees, $285,572.54 was authorized.

For epidemic aid, clinics, respirators, splints and frames, nursing and medical help to communities, organizations and institutions during emergencies, $89,048.13 was spent.

For education, $154,091.11 was expended for nursing and physiotherapy instruction, publications, motion pictures and health exhibits.

During the past year over a thousand new chapters composed entirely of volunteers were formed at a cost to the foundation of $23,885. To-day 1,500 counties are served by chapters. Chapters aided needy infantile paralysis victims regardless of their age, race, color or creed. This assistance included financial help for the purchase of orthopedic equipment and services and for the payment of medical, hospital and nursing expenses. For these purposes $1,137,222 was left with the chapters in 1941. Volunteer groups also aided doctors and public health officials in carrying out the epidemic program in Alabama, Georgia, Mississippi, Pennsylvania and in many other emergency areas.

PRESENTATION TO WILFRED HUDSON OSGOOD

THE sixty-sixth birthday of Dr. Wilfred Hudson Osgood, of the Field Museum of Natural History, of whose staff he has been a member for thirty-two years, has been memorialized by the publication of a testimonial volume of four hundred pages.

According to the official statement the book opens with two dedicatory articles. One is by Stanley Field, who became president of the museum in 1909 (in the same year that Dr. Osgood joined the staff) and has continued at the head of the board of trustees ever since. The other is by Major Clifford C. Gregg, director of the museum. Mr. Field and Major Gregg both express their appreciation of Dr. Osgood as a man and of his scientific work, and give reminiscences of his career. In the pages that follow the biographical sketches appear eleven scientific articles by zoologists on the staff of the museum and by colleagues of Dr. Osgood in the study of mammals from other institutions both in this country and abroad. The book, entitled "Papers on Mammalogy," appears as Volume 27 of the Zoological Series of the museum.

A specially bound copy was presented to Dr. Osgood on December 8, simultaneously with the beginning of international distribution of the edition of several hundred copies to scientific institutions and scientific workers.

Dr. Osgood's scientific career covers a period of forty-four years. A graduate of Stanford University, he took his Ph.D. degree at the University of Chicago. For twelve years prior to going to Field Museum, he was a biologist on the staff of the U. S. Biological Survey. He joined the staff of Field Museum on July 1, 1909, as assistant curator, and became chief curator of the department of zoology in 1921, continuing in that capacity until his retirement from active service on December 31, 1940. Since his retirement he has retained his association with the museum as curator emeritus, and has continued the pursuit of various important researches with undiminished enthusiasm.

Dr. Osgood has led many expeditions for Field Museum, in South America, Africa and Asia. Among the most important were the Marshall Field Expedition to Chile in 1922–23, the Magellanic Expedition of Field Museum which in 1939–40 explored and collected in the southernmost reaches of South America rounding out the explorations of 1923, and the Chicago Daily News-Field Museum Abyssinian Expedition in 1926–27. He personally financed and conducted an expedition to French Indo-China in 1937.

In the closing paragraph of his preface to the testimonial volume, Stanley Field, president of the museum, writes: "The great growth of Field Museum has coincided with Dr. Osgood's régime as chief curator of zoology. This growth has been two-fold, in the direction of exhibition on one hand and in the development of the scientific collections and researches based on them on the other. No one in Field Museum's organization has played a more active or more effective part in this vital developmental period of the museum than has Wilfred Hudson Osgood."

AWARD OF THE DAVY MEDAL OF THE ROYAL SOCIETY TO DR. DAKIN

AT the anniversary meeting of the Royal Society at Burlington House on December 1, the Davy Medal was presented to Dr. Henry Drysdale Dakin, of Scarsborough, New York. Sir Henry Dale in making the presentation spoke as follows:

Dakin began his researches in the field of biochemistry early in the present century. At that time, in comparison with knowledge of the end-products of metabolism, relatively little was known about the chemical activities of the living cells of the animal body. His work has made very important additions to knowledge of the intermediary changes produced by these activities, and also of the chemical structure of natural components of the tissues.

One side of Dakin's work has dealt with enzymes of the animal organs. He was the first to show that such an enzyme will attack at different rates the two optical isomers in a racemic mixture. With Kossel he discovered the enzyme arginase, with its important rôle in the production of urea from arginine. Later he discovered the enzyme glyoxalase, the wide distribution of which in the tissues must indicate some important though still undefined function in carbohydrate metabolism.

In connection with the intermediary metabolism of fatty acids, Dakin produced the first convincing evidence of oxidation at the β-carbon atom as the first stage of their utilization by the body, and showed that this type of oxidation can even be reproduced *in vitro* by the action of hydrogen peroxide.

Dakin's work on the chemistry of the proteins has included a method of partial racemization, bringing subtle differences of molecular pattern into view, which could be related to specific antigenic differences. He also introduced a method of separation which enabled new hydroxy-amino acids to be recognized, and raised much nearer to unity the proportion of a protein molecule accounted for as known amino-acids. At a wide interval of years, Dakin has made two notable contributions to the chemistry of hormones. In 1905, he was responsible for the first published artificial synthesis of a hormone, adrenaline. In 1936 he described the isolation from liver of a substance which is, at least, a principal factor in the important effect of liver extracts on pernicious anemia.

Working in France during the War of 1914–18, Dakin introduced the use of a buffered hypochlorite solution for irrigating infected wounds. Later, on a ship bringing the sick and wounded from Gallipoli, he made a similar solution by direct electrolysis of sea-water. Another war is reviving the use of such preparations to meet the same and other needs.

Though Dakin has worked in a private laboratory, with but rare collaboration and no pupils, his work has exercised a wide and powerful influence on the growth of biochemistry and on the strengthening of its links with organic chemistry.

SCIENTIFIC NOTES AND NEWS

THE Charles Reid Barnes life membership of the American Society of Plant Physiologists has been awarded to Dr. Benjamin M. Duggar, of the University of Wisconsin, "in recognition of his outstanding contributions in the field of plant physiology." The award was presented at the annual dinner held during the eighteenth annual meeting of the society at Dallas.

THE Thomas Burr Osborne Medal in cereal chemistry of the American Association of Cereal Chemists has been awarded to Dr. Ross Aiken Gortner, chief of the division of biochemistry of the University of Minnesota, "for distinguished services in conducting research and training students." The medal will be presented at the annual meeting of the association next May.

DR. G. MARSHALL KAY, assistant professor of geology, Columbia University, has been awarded the George Frederick Kunz Prize for 1941 of the New York Academy of Sciences for his paper on the "Development of the Northern Allegheny Synclinorium and Adjoining Regions." Dr. Otto H. Haas, research associate in paleontology at the American Museum of Natural History, will receive one of the A. Cressy Morrison prizes of $200 for his paper, "The Vernay Collection of Cretaceous (Albian) Ammonites from Angola."

THE Atwood award of $500 for research in physical geography was granted to Dr. George B. Cressey, chairman of the department of geology and geography at Syracuse University, at the annual meeting of the Association of American Geographers in New York City. Dr. Cressey's project calls for a study of land forms in New York State, and is the outgrowth of a National Research Council Committee working on larger aspects of the problem.

The News Edition of the American Chemical Society states that Dr. Fritz Hofmann, director of the Silesian Institute for Coal Research, has received the Goethe Medal for Arts and Sciences in recognition of research relating to production of synthetic rubber.

DR. GARY N. CALKINS, professor emeritus of protozoology at Columbia University, was recently honored by his former graduate students. A representative group, headed by Professor L. L. Woodruff, of Yale University, made a surprise visit to his Scarsdale home to present gifts and greetings. One of the gifts was a handsomely bound volume of letters containing

expressions of high regard and affection from students, associates and numerous friends.

DR. CHARLES P. OLIVIER, professor of astronomy at the University of Pennsylvania and director of the Flower Observatory, succeeds Dr. George Rosengarten as president of the Rittenhouse Astronomical Society. The address as retiring president of Dr. Rosengarten was entitled "Galileo, Scientist and Man," commemorating the three-hundredth anniversary of Galileo's death.

DR. FRANCIS O. SCHMITT, professor of biology at the Massachusetts Institute of Technology, has been appointed head of the department of biology and biological engineering. The courses in public health, hitherto given in this department, will be continued under the administration of a separate department in charge of Dr. Clair E. Turner, professor of biology and public health. Dr. Schmitt, whose appointment becomes effective next July, will succeed Dr. Samuel C. Prescott, who will retire next June.

AT the School of Biological Sciences of the University of Tennessee, Dr. Kendall B. Corbin, head of the department of microscopic anatomy, succeeds the late Dr. August H. Wittenborg as chief of the division of anatomy. Dr. Corbin continues as professor of microscopic anatomy. Dr. Arthur P. Richardson, assistant professor of pharmacology at Stanford University, has been appointed associate professor of pharmacology and head of the department of pharmacology. Dr. Samuel B. Barker, research fellow in medicine at Cornell University Medical College, has been appointed instructor in the department of physiology.

C. BERTRAND SCHULTZ, since 1927 a member of the Nebraska State Museum, University of Nebraska, and since 1938 assistant director, has been appointed director, succeeding Erwin H. Barbour.

DR. JOHN E. ANDERSON, director of the child welfare institute, University of Minnesota, has been appointed chairman of the Minnesota committee of the White House Conference on Children in a Democracy.

Museum News reports that J. Eric Thompson, of the staff of the Carnegie Institution of Washington, has been given an honorary appointment as research associate in Middle American archeology by the Field Museum of Natural History.

THE Society for Research on Meteorites has appointed Henry W. Nichols, chief curator of geology of the Field Museum, Chicago, as a member of the Committee on Legal Ownership of Meteorites and of the Committee on Terminology.

DR. MAX LEVINE, professor of bacteriology in Iowa State College and major in the Sanitary Corps, has been called to service with the second medical laboratory of the third army, at Fort Sam Houston, Texas.

DR. ANTOINE M. GAUDIN, Richards professor of mineral dressing at the Massachusetts Institute of Technology; Dr. William H. Hobbs, professor emeritus in the department of geology, University of Michigan, and Dr. Francis A. Thomson, president of the Montana School of Mines, Butte, have been appointed delegates from the Carnegie Endowment for International Peace to the first Pan American Congress of Mining Engineering and Geology, which meets at Santiago, Chile, from January 15 to 24. Dr. Hobbs is the only one of the delegates who is in attendance. The congress was organized by the Institute of Mining Engineers of Chile under official auspices by decree of the government of Chile, and the South American Union of Engineers.

PROFESSOR D. L. HOLL, of the department of mathematics of Iowa State College, gave a series of lectures at Brown University from January 6 to 8 on the energy theory of thin plates.

DEAN GEORGE F. KAY, formerly head of the department of geology of the State University of Iowa and Iowa state geologist, will deliver the Bownocker lectures of the Ohio State University on January 21 and 22. Dean Kay will give two lectures in the department of geology and one before Sigma Xi. The titles are: Ancient dust storms—the loesses, Duration of the glacial period and the Glacial period in Iowa.

DR. FRANK H. JOHNSON, professor of microbiology at Princeton University, gave on January 6 a lecture on "A Common Mechanism in the Biological Effects of Temperature, Pressure and Narcosis" before the Sigma Xi Club of North Carolina State College. For the work described in this paper, Dr. Johnson and his associates received the $1,000 award of the American Association for the Advancement of Science.

THE thirteenth spring meeting of the American Society for Testing Materials and the society's committee week will be held in Cleveland, from March 2 to 6, inclusive, with all sessions at the Hotel Cleveland.

THE annual meeting of the Federation of American Societies for Experimental Biology will be held at Boston from April 1 to 6. At the Chicago meetings, the proposal to publish a Federation Proceedings was ratified and its quarterly publication will commence in 1942. The March issue (1942) will contain the abstracts of papers for all societies and will replace the usual preprints. Two subsequent issues will be devoted to joint session and symposium papers, and the December issue will replace the present yearbook. The Control Committee consists of W. O. Fenn, *chair-*

man, Philip Bard, C. G. King, Morton McCutcheon, C. F. Schmidt, A. H. Smith and D. R. Hooker, managing editor.

THE British Association of Scientific Workers held a conference in London on January 10 and 11 on "Science and the War Effort." There were sessions on food and agriculture, building, housing and air raid protection, training of technical personnel, science in the services and industrial production. Dennis P. Riley, foreign relations officer, reports that there will be a broadcast to the United States by some of the participants in the conference on Saturday, January 17. He also states that "Science and the World Order," a Penguin volume, will be issued shortly. The book is an outgrowth of the deliberations and discussions of the British Association conference of September, 1941.

A SYMPOSIUM on Viscosity, Molecular Size and Molecular Shape will be held on February 20 under the sponsorship of the American Society of Rheology at the Polytechnic Institute of Brooklyn. M. L. Huggins, of the Eastman Kodak research department, will make an address on "Theoretical Fundaments Concerning the Connection between Viscosity, Molecular Size and Molecular Shape." This will be followed by a discussion. In the afternoon Dr. M. A. Lauffer, of the Rockefeller Institute for Medical Research, Princeton, N. J., will speak on "Experimental Methods and Facts."

THE formal celebration of the fiftieth anniversary of Drexel Institute of Technology, Philadelphia, planned for the spring of 1942, has been postponed. It has been decided to cancel further plans owing to the present war crisis.

A NEW laboratory to be used for pathology and research in ophthalmology has been opened at the University of California. Dr. Michael J. Hogan, of San Francisco, has been made director of the new unit. The laboratory was made possible by a fund of $70,000, known as the Charles Taylor Reeves Foundation, the income from which is to be used in the study of diseases of the eye. The building was made possible by a gift from Mrs. E. S. Heller.

DR. ALLEN T. NEWMAN, dean of the New York University College of Dentistry, has announced that because of the pressing need for specialists in dental reconstruction and rehabilitation, the College of Dentistry of New York University has established a comprehensive graduate program for the training of clinical and research workers.

A CARD index of x-ray diffraction data for use in the Hanawalt Method of Chemical Analysis by X-ray Diffraction has been published by the American Society for Testing Materials. The data include not on Hanawalt's original published data, with his la corrections, but also additional data that have be contributed by Hanawalt, by the Aluminum Co pany of America and the New Jersey Zinc Compa together with data taken from the technical literatu of the English language. It has been assembled by joint committee of the National Research Council a the American Society for Testing Materials, the pe sonnel of which is made up of members of the Co mittee on X-ray and Electron Diffraction of the Di sion of Chemistry and Chemical Technology of t National Research Council and representatives fr the Committee on Chemical Analysis of Metals a the Subcommittees on Metallography and Radi graphic Testing.

BEGINNING with Volume 3, 1942, the name of t "Bibliography of Pharmacology" will be changed the "Bibliography of Pharmacology and Chemoth apy." No change in scope is contemplated; "chem therapy" is added only to make the title more acc rately descriptive. The field of the bibliography defined as: "A reference list of current Americ and foreign literature relating to the action of kno chemical compounds (natural or synthetic) on ani organisms and to therapeutic use of such compoun including clinical investigations but not includi routine clinical and case reports." Requests for m information or for a specimen page may be addres to the Hooker Scientific Library, Central Colle Fayette, Mo.

Nature states that, according to the annual rep for 1939 of the Public Health Commission in In the outstanding feature in that year was the large crease in the incidence of cholera. Whereas in 19 deaths from the disease in the Punjab numbered 5,6 in 1939 they were only 19. Improved sanitation of t villages and towns through which pilgrims pass is t most effective method of prevention, but is a sl process, and in the meantime the best practical meth is anti-cholera inoculation, its compulsory enfor ment being the best practical measure. Of the ann six million deaths in India a fifth or a quarter is a tributed to malaria, to outbreaks of which India everywhere subject, except in areas 5,000 feet abo sea-level and a few widely separated regions. In t large cities such as Bombay and Delhi control m sures are being successfully carried out, but ru malaria is a difficult problem. The general policy provincial authorities is to provide an adequate supp of quinine or cinchona febrifuge to popularize the u of these drugs and to provide for their distributi by traveling dispensaries. The greatest source danger from yellow fever lies in the air-traffic passi

through infected areas in Africa. Under government rules any person who has been in a yellow fever area is forbidden to enter British India until nine days after exposure, unless he has been inoculated or is protected by a previous attack.

THE U. S. Civil Service Commission has announced examinations for "Junior Professional Assistant and Student Aid" designed to recruit college graduates and junior and senior students for positions in the government service. Optional branches include (all in the junior grade at $2,000 a year): agricultural economist, agronomist, aquatic biologist, archivist, bacteriologist, biologist, chemist, entomologist, forester, geologist, junior in household equipment, olericulturist, pomologist, public welfare assistant, range conservationist, soil scientist, State Department assistant and statistician. A four-year college course leading to a bachelor's degree is required, with major graduate or undergraduate study in the field of the optional subject. Senior or graduate students may be admitted to the examination, and may, upon attaining eligibility, receive provisional appointment, but can not enter on duty until evidence of the successful completion of the required college course is furnished. Applicants must not have passed their thirty-fifth birthday. Student aid positions pay $1,440 a year. Usually employment is during the school vacation periods; when furloughed, appointees may return to their college studies. Applicants for these positions must not have passed their thirteith birthday. Applications for both these examinations must be on file with the Washington office not later than February 3.

DISCUSSION

CONTINENTAL DRIFT AND PLANT DISTRIBUTION

NORTH AMERICA and Eurasia, which comprise the major part of the earth's land surface, lie entirely within the Northern Hemisphere, and it is evident that the two continents have always been more or less intimately connected. This is shown especially in the marked similarity of the vegetation, particularly in the higher latitudes.

There are many identical or closely related species throughout the Arctic and subarctic zones, including species of pines, spruces, firs and some other conifers, as well as some deciduous trees, and shrubs like the birches and willows. Further south, in the more temperate latitudes, such common deciduous trees as oaks, chestnuts, beech, maples, elms and others are much the same, in North America and Eurasia.

The greater part of North America is north of the Tropic of Capricorn and extends beyond the Arctic Circle. Practically the whole of the United States is within the "temperate" zone. Except for the Pacific Coast and the Gulf States the climate is a pronounced continental one, with wide range of temperature between summer and winter; and for the most part, winter is a season of almost complete cessation of active vegetation.

The southern continents, South America, Africa and Australia, are separated by the great oceans, nevertheless they have much in common in their vegetation, indicating some former land connections.

The major parts of South America and Africa lie within the Tropics. The southernmost point of South America, Cape Horn, is less than 60° S. There is nothing corresponding to the Arctic and subarctic floras of the Northern Hemisphere, and the land areas of the South Temperate zone are relatively limited in extent. The climate is more of an insular than continental type, and there is no such difference between summer and winter temperatures, as occurs in corresponding northern latitudes.

A comparison of the north and south temperate floras of the Western Hemisphere shows they have little in common except some cosmopolitan genera. The conifers and most of the dominant deciduous trees and shrubs of North America are absent from South America. The conifers of South America are austral genera, absent from North America, *e.g.*, Araucaria, Podocarpus, Fitzroya, and others, while there are many evergreen Angiosperms, *e.g.*, Myrtaceae, Proteaceae, unknown in temperate North America.

While there is thus little connection between the temperate floras of North and South America, there are many common genera and even species in Chile and New Zealand—separated by the whole Pacific Ocean; and the tropical floras of equatorial Africa and South America have also many common genera and even species. An exception to the rule of the absence of North American temperate species in South America is seen in a considerable number of common species in Central Chile and California. This is presumably a case of migration along the continuous mountain range extending along the Pacific Coast from Chile to Alaska.

FOSSIL EVIDENCE

The many investigations of the fossil floras of North

America indicate that the Tertiary genera and some species were much like those of the present; but the geographical distribution has in many cases shifted. Most remarkable is the occurrence in Greenland and Alaska, actually well within the Polar Circle, of fossils belonging to genera now found in warm temperate or even sub-tropical regions.

It is difficult to imagine any possible conditions of climate in which these plants could grow so near the Pole, deprived of sunlight for many months of the year. The occurrence of so many related species in the at present widely sundered southern continents can be explained only on the assumption of some former land connections. The theory of Continental drift has been proposed by several writers, notably the recent volume[1] of Dr. A. S. du Toit. du Toit is influenced by the work of Wegener, but differs from Wegener in assuming two primordial continents, a northern one, Laurasia, and a southern one, Gondwana, instead of Wegener's "Pangaea." From Gondwana were separated the four present southern continents, which finally drifted to their present locations. This theory would best explain most of the problems in the geographical distribution of the floras of the Southern Hemisphere.

DOUGLAS H. CAMPBELL

STANFORD UNIVERSITY

SCLEROTIUM BATATICOLA, A CAUSE OF DAMPING-OFF IN SEEDLING CONIFERS

Sclerotium bataticola Taub. was isolated from young Norway spruce seedlings by Dr. L. W. R. Jackson, pathologist at the Allegheny Forest Experiment Station, in 1935. He later turned over cultures of this fungus to the writer, who has found that it attacks the germinating seeds and early seedlings of Douglas fir (*Pseudotsuga taxifolia* Brit.), Norway spruce (*Picea Abies* (L.) Karst.), American larch (*Larix laracina* (DuRoi) Koch), and the following species of pine-jack (*Pinus Banksiana* Lamb.), red (*P. resinosa* L.), Scotch (*P. sylvestris* L.) and Western yellow (*P. ponderosa* Dougl.). The inoculation experiments were conducted in the laboratory and greenhouses at the Morris Arboretum of the University of Pennsylvania. Pre-emergence and post-emergence damping-off occurred in all species mentioned. *Sclerotium bataticola* was reisolated from all stages of damped-off seedlings.

Under the conditions of these preliminary experiments, the pathogenicity of *Sclerotium bataticola* was thus confirmed for the species of conifers mentioned.

SPENCER H. DAVIS, JR.

UNIVERSITY OF PENNSYLVANIA

[1] "Our Wandering Continents." London, 1937.

PHYSICS IN NAZI GERMANY

IN SCIENCE for November 1, there was published a letter from an unidentified correspondent in Russia, which seems to imply that the Nazi authorities in Germany condemn "theoretical physics" as "Jewish physics" because of its Jewish origin. Is it not far more likely that the present masters of Germany discredit those particular branches of theoretical physics which are commonly known as quantum theory and relativity because they do not find them useful, and call them Jewish to disparage the Jews?

We in America hate tyranny—whether it be tyranny of men or tyranny of ideas. We should accord abtruse theories respectful consideration if they are both honest and able attempts to account for observations not previously fully accounted for, but we should not permit them to tyrannize. Your correspondent, however, disparages Stork because "it is obvious that the author tries to refute the modern theory of quantum mechanics." Since when has this become an offense? Quantum theory has not been deified in America, and undoubtedly there are still "thirty thousand men in Israel" who have not bowed down before it. Endeavors to confirm the quantum theory are still made in abundance. Should the few who seek unification of science along other lines be disparaged as necessarily anti-Jewish?

The true status of these two branches of modern physics, so far as the general public is concerned, is about as follows: Even Mr. Einstein has not yet been able to reconcile relativity and quantum theory, though he has made the endeavor to do so almost a life work. There has been no derivation of the electromagnetic theory from the principles of quantum mechanics, although a reconciliation between the two was promised and has been hoped for. Even Bohr now says that quantum principles do not apply in nuclear physics.

Relativity has not been applied to any attempt to control phenomena. Quantum terminology has been adopted in spectroscopy, and is used in all spectral classification work, there being as yet no other. The "numerous remarkable discoveries" attributed to quantum theory are at least chiefly due to classification schemes, and not necessarily to the idea of monochromatic unidirectional radiation quanta produced by losses of energy by moving electrons. The electromagnetic theory, however, has been vastly extended in its usefulness.

There seems to be a need for search for modes of interpreting phenomena that are not bound *a priori* to any postulates that seem irreconcilable to what is too often referred to disparagingly as "classical theories."

Nazis may couple men and ideas for the purpose of

disparaging both. We should avoid any such confusion, either to disparage or to exalt a theory.

WM. MAYO VENABLE

PITTSBURGH, PA.

A SCIENTIST AT PEACE AND AT WAR FOUR HUNDRED YEARS AGO

THE manner in which one great scientist of the past, Nicolò Tartaglia of Brescia (*c.* 1500–1577), conducted his conscience in the face of the differing requirements of peace and war, may not be without some interest to scientists of the present day who find themselves in a similar situation.

In the "Epistola" to his "Della Nuova Scienza," written at Venice 20 December 1537 (O.S.), and addressed to his Excellency the Duke of Urbino, Tartaglia writes:

> When I was living in the town of Verona, Illustrious Duke, one of my intimates, my cordial friend the master of ordnance at the old castle, (a man of experience and great skill in his art, and endowed with an abundance of good qualities), asked me one day my opinion how to aim a piece of artillery to give it the greatest range. Although I had no practical knowledge whatever of artillery, for in truth, Excellent Duke, I have never in my life shot a single round with firearms, arquebus, bombard or musket, nevertheless, being desirous of serving my friend, I promised shortly to give him a definite answer to his question.[1]

Tartaglia then proceeds to give an account of his attack upon the problem set him by his friend, and then goes on to remark:

> As the result of this I had the intention of writing a treatise on the art of artillery, and to bring it to a degree of perfection capable of directing fire in all circumstances, assisted only by a few particular experiments: for as Aristotle says in the seventh book of the "Physica," Section 20, "particular experiments are the basis of universal science."
>
> But, since then, one day meditating to myself, it had seemed to me that it was a thing blameworthy, shameful and barbarous, worthy of severe punishment before God and man, to wish to bring to perfection an art damageable to one's neighbour and destructive to the human race, and especially Christian men in the wars that they wage on one another. Consequently, not only did I altogether neglect the study of this matter and turned to others, but I even tore up and burnt everything which I had calculated and written on the subject, ashamed and full of remorse for the time I had spent on it, and well decided never to communicate in writing that which against my will had remained in my memory, either to please a friend or in teaching of these matters which are a grave sin and shipwreck to the soul.[2]

In view, however, of the preparations of the Turks to invade Italy, who, as Professor J. D. Bernal has pointed out,[3] were instigated by his Most Christian Majesty the King of France,[4] Tartaglia suffered a change of mind. He writes:

> To-day, however, in the sight of the ferocious wolf preparing to set on our flock, and of our pastors united for the common defence, it does not seem to me any longer proper to hold these things hid, and I have resolved to publish them partly in writing, and partly by word of mouth, for the benefit of Christians so that all should be in a better state either to attack the common enemy or to defend themselves against him. I regret very much at the moment having given up this work, for I am certain that had I persevered I would have found things of the greatest value, as I hope yet to find. . . . I hope that your Lordships will not disdain to receive this work of mine so as better to instruct the artillerymen of your most illustrious government in the theory of their art, and to render them more apt in its practice.[5]

M. F. ASHLEY MONTAGU

DEPARTMENT OF ANATOMY,
HAHNEMANN MEDICAL COLLEGE AND
HOSPITAL, PHILADELPHIA, PA.

[1] "Della Nuova Scienza," in "Questi et Invenzioni Diverse de Nicolo Tartaglia, Di nouo restampati con vna Gionta al sesto libro, nella quale si mostra duoi modi & continentia di tutta l'opera nel seguente foglio si trouara notata." [Venezia, 1550], (p. 1). I have not been able to see an earlier edition of this work, and so translate from the only edition available to me.

[2] *Ibid.*, p. 6.

[3] J. D. Bernal, "The Social Function of Science," p. 169. New York: The Macmillan Co., 1939. The second and third parts of the translations here given from Tartaglia are from the version in Bernal's excellent work. The passages are incorrectly attributed by him, on the basis apparently of a French translation, to a section entitled "L'Art de jecter les bombes."

[4] The modern parallel is, of course, Hitler playing Mephistopheles to Japan's Faust.

[5] Tartaglia, *loc. cit.*, p. 6.

SCIENTIFIC BOOKS

THE EARTH

Biography of the Earth. By GEORGE GAMOW. 242 pages; 35 plates; 58 figures. New York: Viking Press. 1941. $3.00.

THE barriers between the sciences are now quite generally down, and no geologist will think that even a professor of theoretical physics is poaching on forbidden territory when he writes such a book as this. On the contrary, geologists will thank Dr. Gamow for making the history of the earth so interesting to the layman by his lucid, fluent style, his enthusiasm for the subject, and his wise selection of items to be stressed. Certainly, the truly fascinating story of the origin, infancy and adolescence of an earth, still far from decrepit old age, has seldom been told with such verve and ingenuity of phrase, combined with essen-

tial accuracy and fidelity to technical lore, as that which characterize this book.

After all, geology is in the nature of the case an application of the principles of physics, chemistry and biology to the study of the earth and its inhabitants. Whereas, analysis—the learning of more and more about less and less—is essential to the discovery of knowledge, it is equally true that synthesis—the assembling of the jigsaw puzzle into a unified and comprehensive picture—is essential to the dissemination of knowledge. Many scientists, fortunately, are now accepting responsibility for the second as well as the first of these two tasks. None is fulfilling that duty more satisfactorily than Dr. Gamow. The book now in hand, together with its predecessor, "The Birth and Death of the Sun," will give the general reader an accurate perception of the vast sweep of cosmic history and a true perspective of man's place in the universal scheme of things.

There are of course a few details of geologic fact and theory, as set forth by Dr. Gamow, that could be questioned, but with one exception these are minor matters and detract little from the general merit of his work. One serious flaw ought to be called to his attention. It involves the great unsolved geological problem for the solution of which the assistance of the physicist is essential. Dr. Gamow ascribes mountain-making to earth shrinkage, although he correctly computes as extremely small the amount of such shrinkage that could be attributed to decrease in internal temperature during the last few hundred million years. This, he asserts, is nevertheless adequate to explain the height of mountain systems above adjacent lowlands or sea floors. That is doubtless true, but the problem of mountain-making processes is a vexing one, not because of the height of mountains but because so many of them are composed of tangentially compressed and overthrust rocks that indicate scores of miles of circumferential shortening of the earth's crust. Radial shrinkage as a result of decrease in the earth's body temperature is woefully inadequate to cause the observed amount of horizontal compression. Therein lies the real perplexity of the problem of mountain-making. Geologists have not yet found a satisfactory escape from this dilemma; perhaps Dr. Gamow will pursue the subject farther.

KIRTLEY F. MATHER

HARVARD UNIVERSITY

BANCKES'S HERBAL

An herbal [*1525*]. Edited by SANFORD V. LARKEY and THOMAS PYLES. New York: New York Botanical Garden. 1941. $3.50.

THE early literature of plants was closely associated with that of drugs. Most of the prescriptions, although fearfully and wonderfully compounded, were based primarily upon plants or their derivatives. The student of plants was almost always a physician, and unless he knew of some supposed virtue in a plant or could discover (or imagine) one on his own account, that plant was beneath his notice.

Various compilations relating to plants and their medicinal uses existed in manuscript form long before the invention of printing, and it is not at all strange that the practitioners of the new art should seek to embalm the accumulated wisdom of these manuscripts in the printed page. The resulting volumes, called "herbals," were very popular, and often went through various editions. But they were usually printed in Latin, and it was not until many years had passed that one appeared in English.

At last two English herbals made their appearance, and were so popular that they were both reissued repeatedly, with slight changes, within fifty years. One was a folio called the "Grete herball," the other a small volume, of which the earliest known edition is now reprinted. Both were anonymous compilations; the present one, dated March 25th, 1525 (the first day of the year, according to the calendar then in use), is known as "Banckes's Herbal," from the name of the printer, Richard Banckes.

It came to the notice of the management of the New York Botanical Garden that the "Scholars' Facsimiles and Reprints" of New York were planning to issue this reprint, and arrangements were made by which it has appeared as a publication of the Garden. The editing and transcription into modern English are by Dr. Sanford Vincent Larkey, of the Johns Hopkins University, and Professor Thomas Pyles, of the University of Maryland, who also prepared the scholarly introduction. The original black-letter book, of 72 unnumbered pages, is reproduced in facsimile, and this is followed by a much more readable transcription, with numerous corrections of spelling, punctuation and capitalization, and the occasional substitution of a word that will make the author's intent more intelligible to a modern reader. The corrections, however, have been made sparingly and judiciously, so as not to interfere with the quaintness of the original text.

The facsimile reproduction is from a copy in the library of the British Museum; the only other known copy is in the Henry E. Huntington Library in California. The New York Botanical Garden is to be congratulated upon placing this little classic, so well printed and edited, in the hands of the medical, botanical and horticultural public.

The statement in the introduction that this "was the first book devoted exclusively to herbs to be printed in England" is certainly open to question,

unless modified by the words "of which a copy is now known to exist." It is true that the earliest copies of the "Grete herball" now known are dated July 26, 1526, but this was certainly not the first edition, and good evidence exists that in its first form it was dated June 20, 1516—nearly nine years earlier than Banckes's Herbal.

JOHN HENDLEY BARNHART

REPORTS

SCIENTIFIC WORK OF THE CARNEGIE INSTITUTION OF WASHINGTON[1]

A REVIEW of all the activities of the institution would make interesting reading, but it will have to wait until the time comes when the full story can be told. It is now impossible to mention fine work being done by many of the staff members of the institution, since it remains in a confidential category.

The normal research activities of the staff, in view of the interruptions and distractions now present, are not inconsiderable. The full Year Book gives the record, again with an interpretive statement by each director of a department or division. Here a few high lights will be noted, in the hope that this will lead to further perusal.

In spite of preoccupation of most of the staff members of the Department of Terrestrial Magnetism with defense research, the fundamental program of this department still continues significantly. Unless further delays accrue in procuring materials for which priorities are sought, the cyclotron will shortly be completed and made available for cooperative studies in which the Department of Embryology and the Department of Genetics will have a part. Searchlight studies of the electrical and chemical conditions of the air at great heights are also progressing, as well as coordination of magnetic, solar and upper-air studies as related particularly to problems of radio transmission.

Dr. Adams reports from Mount Wilson a number of interesting results. To seize upon one of these, he tells of the first definite evidence of the presence of iron in interstellar space, the density being such that there is present roughly one atom in a cubic meter. This is a very low density. The best vacuum man has produced artificially still contains gas many million times as dense. Yet interstellar space is so enormous that the mass of material represented in these gases is large, and the significance of the discovery may be great. Continued study of atomic and molecular spectral lines from this vast area may in time give us not only the composition but also the distribution and motions of the clouds of cosmic dust and gas that inhabit it, and provide much knowledge of the physical state of its matter. Another item relates to the discovery of the remains of Kepler's Nova of 1604 through the use of red-sensitive plates, and its recognition as the third supernova to appear in the observable region of the galactic system within the last 900 years. Finally, the vexed question of the direction of rotation of the great universes of stars represented by the spiral nebulae seems to have received a definite answer. The evidence shows clearly that in each of the objects investigated the spiral arms are trailing as the nebula rotates. This result is of fundamental importance in theories of the origin and dynamics of stellar systems.

Completion of construction of the 200-inch telescope at California Institute of Technology has been somewhat retarded by pressure of defense research activities, but we continue to cooperate closely in this program, and in consideration of plans for future operation of the giant telescope. In accordance with agreement reached in 1936, tapering financial support which the institution has provided for the seismological program at California Institute will terminate this year.

The Geophysical Laboratory has been concerned with investigation of the radioactive content of rocks as a vital factor in many geophysical problems, and as a part of this undertaking determination of radioactive elements in deep-sea cores obtained by Piggot from the Caribbean Sea has developed new and fundamental relationships. In this connection also a special study of radioactive elements in sea water has been carried out during the past year. Ultrabasic, deep-seated rocks make up the fundamental material of the earth's structure, and the whole problem of the thermal conditions of the earth depends largely on the radioactive content of certain of these rocks. It has now been possible to initiate a cooperative study concerning determination of age and heat production relating to rock formation. The equipment for studying silicate minerals in the presence of water at high temperatures and pressures such as prevail deep within the earth has produced a variety of interesting results. This apparatus is essentially an electric furnace within a strong closed chamber in which materials can be exposed to the action of steam at pressures of several thousand pounds and at temperatures far above a red heat. In the course of some experiments on solubility and melting point the formation of clear quartz crystals at a fairly rapid rate was observed.

[1] From the annual report of Dr. Vannevar Bush, president of the Carnegie Institution of Washington.

Other arrangements of the apparatus caused an unusual deposit of minerals formed by a solution of material in the vapor phase, followed by deposition in another part of the furnace. One of these minerals was sillimanite, which formed long needles of good size. This is the first time that this mineral has been obtained artificially, and it is probable that the manner of its formation in nature is similar in some respects to that here observed.

Further progress in studies on photosynthesis is reported from the Division of Plant Biology. Recent research relating to the chemical mechanism of the photosynthetic process has necessitated a considerable revision of the older set of hypotheses in regard to the chemical interactions involved. Refinement of existing methods of chemical analysis of the precise nature of the product formed by photosynthesis is being undertaken, and new materials are being subjected to photosynthetic measurements, including certain diatoms under culture. All lines of evidence, morphological, ecological, genetical and cytological, are brought to bear on problems concerning the analysis of plant relationships, in studies in the field of experimental taxonomy. These various methods of procedure are serving as effective checks and balances in development of the species concept.

As a result of work at the Department of Genetics, Blakeslee and his associates, by further application of the alkaloid colchicine method in study of the developmental history of the plant, have found that the stamen is evolutionarily a reduced axis and not homologous with a leaf, as is the classic belief. A gene mutant type has been located in *Datura* which so closely resembles the peculiar effects of a certain virus disease that further light is thrown on the question whether there are not close similarities between genes and virus particles, the chief difference between the two, perhaps, being in the fact that the virus particle has unlimited powers of multiplication, whereas the gene is imprisoned within a chromosome and can multiply only when the latter divides.

In accordance with the expressed desire of the trustees of the institution for the development of an effective program for cooperation between the Department of Genetics and the Long Island Biological Association at Cold Spring Harbor, an agreement was reached whereby Dr. Demerec, assistant director of the Department of Genetics, served as director of the Biological Laboratory of the Association during the summer of 1941, and Dr. Corner served as chairman of a scientific advisory committee for the Biological Laboratory program. This arrangement led to a symposium at Cold Spring Harbor on the subject of the gene and chromosome, which attracted a large group of scientists, and which was followed by the annual meeting of the Genetics Society of America. Plans for continuation of such effective cooperation are being formulated in connection with the institution's program of research at Cold Spring Harbor for next year.

The program of the Department of Embryology contemplates an increased use of physiological, physical and chemical methods in expansion of the experimental studies of mammalian embryology. Whatever work is undertaken in the future, however, will be intimately and soundly based upon the understanding of the form and structure of the human embryo which has so remarkably and effectively grown out of the past activities of this department. Dr. Streeter is now engaged in classifying and summarizing the results of these morphological studies on the development of the early human embryo, in fulfilment of one of the original purposes for which the Department of Embryology was established. The full statement of the objectives of the department is presented by the new director, Dr. Corner, after a year of study and consultation with his colleagues, during which time the aims of the program of research have become focused, although so defined as to admit of adaptation as conditions and opportunity may warrant.

Despite cooperation in defense research, which has required attention of staff members of the Nutrition Laboratory, work at the laboratory has progressed in development of instrumental technique and in cooperative studies of carbohydrate metabolism with reference to diabetes.

Dr. Kidder reports the interesting circumstances surrounding the discovery of ancient footprints in a stratified formation in Nicaragua, which was previously reported to the trustees. Investigation is being extended in the attempt to learn, if possible, more about the individuals who made these tracks, and when they made them. Work has proceeded at the ruins of Copan, Honduras, where extensive and necessary repairs are being completed preparatory to the inauguration of a brief but intensive program of archeological study. Continuation of humanistic studies in Middle America has placed the institution in an unusually favorable situation to cooperate effectively in various types of scholarly effort being undertaken in this region by numerous agencies.

Fortunately the institution has been privileged, even under somewhat adverse conditions, to continue its cooperation with a number of other agencies in furthering fundamental studies having direct relation to its major projects. Comments by directors on such subjects will be found in the Year Book, as well as independent reports from some of the investigators who have worked upon cooperative problems during the past year.

SPECIAL ARTICLES

THE ENDOSPERM AS A BARRIER TO INTERSPECIFIC HYBRIDIZATION IN FLOWERING PLANTS[1]

FOLLOWING fertilization between species, development of the seed is frequently arrested short of a condition which permits germination. The line of descent embodied in the hybrid embryo is thus summarily terminated. The question whether collapse is due to defects in the embryo itself or to abnormal behavior of the accessory tissues of the seed is of considerable theoretical and practical interest.

Genetically speaking, the angiosperm seed is a chimera, comprising embryo, endosperm and maternal tissues differing from each other in hereditary organization. The embryo develops from the fertilized egg. The endosperm, which is the product of an independent fertilization, is normally triploid, its primary nucleus receiving two sets of chromosomes from the macrogametophyte. These two structures are enclosed in maternal tissue usually consisting initially of a nucellus and either one or two integuments. Several investigators have considered that a disturbed developmental relationship between these genetically diverse components is responsible for failure in hybrid seeds. The evidence brought forward, however, has not been clear regarding the tissues involved or the character and sequence of events leading to collapse. Formulation of a satisfactory working hypothesis concerning the cause of failure, therefore, was not possible.

Recent investigations in this laboratory indicate that the primary cause of hybrid seed collapse is weak growth of the endosperm. The effect, however, is indirect. The subnormal development, which may be detected soon after fertilization, induces modifications in the associated maternal tissues, which in turn react unfavorably upon the endosperm. The latter becomes starved, the cells break down and the seed collapses.

The embryo, although often retarded, may continue to grow while these changes are in progress. Critical evidence to exclude it is lacking, but there are no positive indications that the embryo itself is a factor contributing to failure. It is still very small, sometimes only just beyond the zygote stage, when the transformations occur in the young seed which appear to determine largely the future course of development. On the other hand, the endosperm at this time is regularly more advanced, which strongly suggests that it, rather than the embryo, is the controlling tissue. Later, of course, the embryo may become the dominant structure of the seed, but failure of the type under consideration, even though it may be delayed, rather clearly has its origin in early post-fertilization behavior.

Since the discovery of double fertilization at the close of the last century and the interpretation of xenia in maize in the light of it, it has been apparent that the endosperm possesses some measure of genetic autonomy. The evidence from xenia, however, relates to the mature endosperm in one of the relatively few families of angiosperms in which the tissue characteristically persists. It casts no light on the extent to which early endosperm behavior is genetically controlled in the far larger proportion of species in which the tissue is present in the young seed, but later disappears. Furthermore, embryological studies have rather consistently underestimated the importance of the endosperm as a factor in early seed development.

Three facts are now established which appear important for an understanding of the type of seed failure in question. (1) In addition to the trophic properties commonly attributed to it, the endosperm plays a basic rôle in the morphogenetic changes involved in transformation of the ovule into a seed.[2] This is clearly shown in *Nicotiana rustica*. Following normal self-fertilization the funicular cells between the apex of the vascular bundle and the chalazal pocket become differentiated into conducting cells. The histological evidence strongly suggests that this important step is a response of the contiguous maternal tissue to the endosperm which is developing very rapidly at the time. The differentiation does not occur if *N. rustica* ovules are fertilized by *N. glutinosa* or *N. tabacum*. (2) Behavior of the endosperm during early post-fertilization stages is significantly influenced by the genetic make-up of the tissue. This fact was established quantitatively in *Medicago sativa*, in which a significant difference in rate of free nuclear division was observed in inbred and crossbred endosperms.[3] It was confirmed in *Nicotiana rustica*, in which the normal endosperm develops much more rapidly than do *N. rustica* × *N. glutinosa* and *N. rustica* × *N. tabacum* endosperms.[4] (3) In seeds which fail, the collapse follows changes in the maternal tissues which arise as a result of hypofunction of the endosperm. Associated with the weakly growing endosperms in self-fertilized *Medicago sativa*[3] and in the above-mentioned Nicotiana interspecific hybrids[4] there is overgrowth of the adjacent maternal tissues which eventually induces signs of starvation in the endosperm itself and precipitates collapse of the seed. It was found that

[1] Paper from the Department of Genetics, Agricultural Experiment Station, No. 293. Assistance is acknowledged from the Rockefeller Foundation and the Wisconsin Alumni Research Foundation. Aid was received also from WPA projects in the Natural Sciences No. 8649.

[2] D. C. Cooper and R. A. Brink, *Genetics*, 25: 593–617, 1940.

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[4] R. A. Brink and D. C. Cooper, *Genetics*, 26: 487–505, 1941.

in *N. rustica* × *N. tabacum* seeds in which collapse is delayed so that a germinable condition may be reached, even though very rarely, the endosperm-nucellus volume ratio at early post-fertilization is higher than in *N. rustica* × *N. glutinosa* seeds, which all fail early.[4] Since the pistillate parent is the same in both crosses, it is evident that the varying degree of abnormal development of the maternal tissue in the two respective classes of seed is a function of the endosperm genotype.

The endosperm, therefore, may act as a barrier to interspecific hybridization in flowering plants. The tissue forms the basis of an isolating mechanism, to use Dobzhansky's[5] term, which tends, like numerous other physiological devices, to hinder the interchange of genes between specific groups.

It is a point of considerable practical interest that failure of the seed due to weak endosperm development does not necessarily imply that the associated embryo is inviable. The lethal mechanism is not in the line of descent but is parallel to and impinges upon a short but critical segment of it. Freed of its adverse environment in the seed before breakdown occurs, the embryo may be capable of growing into a plant. Numerous cases are on record of vegetatively vigorous interspecific hybrids having been reared from badly shrunken seeds which may have barely passed the limits of germinability in their development. If the present analysis is well founded, it is a fair inference that below this threshold there are embryos of many more hybrids the realization of whose potentialities only awaits the application of suitable technics of artificial cultivation. The work of Laibach,[6] Tukey,[7] van Overbeek *et al.*[8] demonstrates the possibilities of rearing incompletely developed embryos on synthetic media. The limits within which plant breeders may be able to explore the possibilities of interspecific hybridization now appear, therefore, to be significantly broader than earlier could have been foreseen.

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ON THE LOCALIZATION OF ENZYMES IN NERVE FIBERS[1]

CHOLINE esterase is highly concentrated at or near the neuronal surface. This was shown recently in experiments on the giant fiber of squids, where practically the whole enzyme activity was found to be in the sheath, only a negligible amount of enzyme being present in the axoplasm.[2] These observations, together with the parallelism, within certain limits, found between number of electric plates per cm, E.M.F. per cm and concentration of choline esterase in electric organs, suggest that the electrical changes observed during nerve activity may be intrinsically connected with acetylcholine metabolism.[3,4] It is necessary to know how specific is the concentration of choline esterase at the neuronal surface compared with other enzymes important for nerve activity. Studies have been started in order to determine the activity of different enzymes separately in sheath and axoplasm of the giant fiber.

Nerve activity is connected with heat production and extra oxygen uptake. Determinations of the total respiration may not yield optimal values if the cell is no longer intact. It appears safer to determine important intermediate steps. Succinic dehydrogenase is widely believed to be essential in respiratory enzyme systems. Its activity has been determined with the manometric method with ferricyanide.[5] Table 1 gives

TABLE 1

SUCCINIC DEHYDROGENASE. K = CONTROL, E = WITH SUCCINATE. TIME 235 MIN. CONCENTRATION OF SUCCINATE 0.15 MOL. t = 23° C.

		Mg fresh tissue	Cmm CO_2		µg succinic acid		
			Observ.	Calc. for 100 mg	Absol.	In per cent. of total	Per 100 mg
Sheath	K	6.7	1.96	29.2			
	E	5.5	4.20	76.7	6.7	11	126
Axoplasm	K	27.5	4.5	16.3			
	E	24.9	24.6	99.0	53.5	89	216

the results of an experiment showing that about 90 per cent. of the total enzyme amount is present in the axoplasm. The concentration is about 50 per cent. lower in the sheath, although the absolute amount metabolized there is so small that the values are near to the limits of sensitivity of the method. Although the greatest part of the sheath is connective tissue, the results give no indication of a higher concentration of succinic dehydrogenase at or near the surface. The contrast to the distribution of choline esterase is striking. In the whole giant fiber the concentration is intermediate between that of sheath and axoplasm, as could be expected. In the head ganglion the concentration of succinic dehydrogenase is about 10 times as high as in the fiber, whereas its concentration of

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[6] F. Laibach, *Jour. Heredity*, 20: 200–208, 1929.
[7] H. B. Tukey, *Proc. Amer. Soc. Hort. Sci.*, 32: 313–322, 1935.
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choline esterase is several hundred times higher than in the fiber.

In one experiment with succinic oxidase the enzyme distribution between sheath and axoplasm was the same as that found for succinic dehydrogenase. The difference of enzyme concentration between fiber and head ganglion was also the same.

The formation of acetylcholine occurs only in oxygen and in presence of either glucose or pyruvic acid.[6] This suggests that the acetic acid is formed from pyruvic acid, a process which probably requires vitamin B_1. Mann and Quastel found that in the brain of vitamin B_1 deficient pigeons acetylcholine formation is accelerated in presence of potassium + vitamin B_1.[7] The greatest part of vitamin B_1 in living tissue seems to occur as diphosphothiamine (cocarboxylase). The concentration of this coenzyme has been determined in sheath and axoplasm. The method used was that of Lohmann and Schuster with slight modifications.[8] Table 2 gives an experiment showing that the concentration in the sheath is twice as high as that in the axoplasm. In view of the large fraction of connective tissue in the sheath these figures definitely indicate a concentration of diphosphothiamine in or near the surface many times as high as that in the axoplasm. The distribution differs from that of choline esterase as well as from that of succinic dehydrogenase and oxidase. It supports the assumption that one function of vitamin B_1 may be its participation in the formation of acetic acid for acetylcholine.

TABLE 2

COCARBOXYLASE. TIME 20 MIN. K = 0.05 μ COCARB.

	Mg fresh tissue	Cmm CO_2	μg cocarboxylase	
			Absol.	Per 100 mg
Sheath	14.0	2.66	0.0315	*225*
Axoplasm	87.0	6.89	0.0785	*90*
K		4.39		

D. NACHMANSOHN[9]
H. B. STEINBACH

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A COLOR REACTION FOR DEHYDROASCORBIC ACID USEFUL IN THE DETERMINATION OF VITAMIN C

WHEN the 2,4-dinitrophenylhydrazine derivative of dehydroascorbic acid is treated with 85 per cent. sulfuric acid, a reddish colored product is formed which absorbs maximally at 500–550 mu and 350–380 mu. The nature of this reaction is illustrated by the following experiment. One cc of a dilute acetic acid solution of dehydroascorbic acid is mixed with one cc of a saturated solution of 2,4-dinitrophenylhydrazine in 85 per cent. H_3PO_4. After letting stand for 5 minutes, 8 cc of concentrated H_2SO_4 is added. The same red color is obtained as that observed when the crystalline 2,4-dinitrophenylhydrazine derivative of dehydroascorbic acid is dissolved in H_2SO_4. If more time is allowed for the 2,4-dinitrophenylhydrazine to couple with the dehydroascorbic acid, a deeper red color is obtained when H_2SO_4 is added. If the three substances involved in this reaction are mixed in any other sequence, the red color is not obtained. Hence, this reaction is due to the action of H_2SO_4 on the coupled 2,4-dinitrophenylhydrazine-dehydroascorbic acid compound.

The proportionality of the color obtained in this reaction is in good agreement with Beer's law. We have used this reaction to develop a simple and rapid colorimetric method for the determination of ascorbic acid. Possible interfering substances are pentoses, glucose and fructose, which in concentrations much greater than usually found in acid extracts of plant and animal tissues will form derivatives with 2,4-dinitrophenylhydrazine. The latter dissolve in 85 per cent. sulfuric acid, giving brown to yellow colors, but they do not react with the acid except when heated or upon long standing. Furthermore, the absorption curves of the sulfuric acid solutions of the xylose, glucose and fructose derivatives of 2,4-dinitrophenylhydrazine, and also of 2,4-dinitrophenylhydrazine, show practically complete transmission in the wave-lengths at which the red color obtained from dehydroascorbic acid is compared. Hence, it appears that a completely specific principle for the determination of ascorbic acid is offered.

In the proposed method, the 2,4-dinitrophenylhydrazine derivative is isolated from unknown and standard solutions of ascorbic acid according to published directions[1] and treated with 85 per cent. sulfuric acid. Colorimetric comparison is made, using a filter with maximum transmission at 540 mu. The method will be published in detail later.

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BINDING OF SULFONAMIDES BY PLASMA PROTEINS

CEREBROSPINAL fluid concentrations of sulfathiazole which occur during treatment of meningitis do not generally exceed 25 per cent. of the plasma concentrations; values for sulfanilamide in the cerebrospinal fluid may reach 100 per cent. of the plasma concentrations, whereas the values for sulfapyridine and sulfadiazine are intermediate. These differences in concentration have been ascribed to differences in the diffusibility of the drugs into the spinal fluid. An alternative explanation would be the existence of part of the drug in combination with plasma protein. Schonholzer[1] has demonstrated binding of the azo-dye of sulfanilamide, Prontosil, to serum albumin in electrophoresis experiments, but this technique does not furnish quantitative data for partial binding. The experiments reported in the present paper support the view that the sulfonamide drugs are bound to plasma proteins in varying proportions, the relative concentration of drug attained in the spinal fluid depending upon the extent to which the drug is bound in the blood.

Normal human plasma was dialyzed in Cellophane bags against 0.15 N. NaCl, buffered at pH 7.4 by the addition of 0.01 M. phosphate, with varying additions of a sulfonamide. At equilibrium the drug concentration was found to be higher in the plasma than in the buffer. While this distribution coefficient is not direct evidence of binding to protein, the data fit the Freundlich adsorption isotherm, as is the case with phenol red,[2] for which direct evidence of chemical binding has been furnished by absorption spectrophotometry.[3] Whether the phenomenon be due to adsorption, coordination, or simply depression of the activity coefficient by the protein is of less biological than chemical interest, for in any case, it is the value of the distribution coefficient which determines the distribution in the body. The binding (using the term in a very general sense) is due to albumin but not to globulin; lipid-free plasma behaves similarly. In normal plasma containing 7 per cent. protein, with drug concentrations of 10 mg per cent., the proportion of "free" (unacetylated) drug which is bound to protein is as follows:

Sulfanilamide	20 per cent.
Sulfapyridine	40 per cent.
Sulfadiazine	55 per cent.
Sulfathiazole	75 per cent.

These data can explain the observed distribution in body fluids and the greater solubility in plasma than in saline.

[1] G. Schonholzer, *Klin. Wchnschr.*, 19: 790, 1940.
[2] A. Grollman, *Jour. Biol. Chem.*, 64: 141, 1925.
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Preliminary bacteriostatic experiments were carried out with *B. coli* in a synthetic medium, with and without added albumin.[4] The results suggest that the concentration of unbound drug determines the level of bacteriostatic activity, the bound drug being apparently inactive. It was also noted that the order of increasing tendency to be bound to plasma albumin was identical with the order of increasing bacteriostatic effectiveness for the four sulfonamides studied.[5] This latter relationship may be of theoretical significance and is being studied further.

It has been demonstrated that the sulfonamide drugs behave as though bound in varying degree to plasma albumin or some fraction thereof, and it appears that the bound drug is not bacteriostatically effective. The effective level of the sulfonamides in the cerebrospinal fluid may therefore be as great as that in the blood stream, and the apparent level compared with the blood should not be used as a guide to the choice of a drug. Inasmuch as excellent therapeutic results have been reported with the use of sulfathiazole in meningococcic meningitis[6] it may be preferable to the more toxic sulfanilamide and sulfapyridine, which have often been favored because of the higher concentrations attained in the cerebrospinal fluid.

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[4] We are indebted to Dr. W. Barry Wood for assistance in the bacteriological work.
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SCIENCE NEWS

Science Service, Washington, D. C.

ELEMENT 61

A FORM of element 61, believed to be the only element of the 92 in the chemist's periodic table not found in nature and never before produced artificially, made a brief appearance as a result of bombardment of other elements with atomic fragments whirled at them by the University of California's cyclotron. The new substance stayed just long enough to show by its radioactivity that it was here and then disappeared completely by disintegration.

The experiments were made by Dr. Emilio Segre, research associate in the Radiation Laboratory, and Dr. Chien Shiung-Wu, research fellow. The rare earths bombarded were sent to Dr. Segre a year ago by an Italian chemist, Dr. Luigi Rolla.

Element 61 belongs to the group of rare earths, of which there are 15. The atomic number 61 means that the nucleus or central core of its atom has a positive charge 61 times that on the nucleus of a hydrogen atom, and this is neutralized by 61 negative electrons revolving about it like planets around a central sun. Each chemical element has various forms, known as isotopes, and one of these of element 61 is believed to have been discovered.

From its position in the periodic table, it is known that the atomic weight of element 61 should be about 148, and its principal chemical and physical properties can be predicted fairly accurately. But unless and until a fairly stable form is found, one that will at least stay long enough to be measured, these predictions can not be verified.

In 1926, Professor B. Smith Hopkins, of the University of Illinois, believed he had captured a stable form of element 61 which he recognized by its x-ray spectrum. It was named illinium. In 1933 Maurice Curie believed that he had isolated an isotope of illinium and noted its radioactivity. Three other elements, numbers 43, 85 and 87, are considered in the same doubtful class.

Albarmine, element 85, and virginium, element 87, were claimed by Professor Fred Allison, of the Alabama Polytechnic Institute. Because of their position among the radioactive elements in the periodic table (radium is element 88), these elements are probably radioactive with short life periods and may have consequently disappeared from the earth. It may be the only way to find them would be to create them artificially by atomic bombardment of neighboring elements.

The case for masurium, element 43, is somewhat stronger. Its discovery was reported almost simultaneously by scientific men in England and in Germany. Also its position in the periodic table is among the stable elements. It should be a metal resembling manganese.

THE PRODUCTION OF ALCOHOL

ALCOHOL can be produced in many ways besides by the fermentation of grains and molasses. With the government taking over 60 per cent. of the output of our distilleries, perhaps some of these alternative methods w come into use. In any case, no serious shortage threaten

Alcohol can be produced from cornstarch, potato wood, in fact from any plants containing starch, sugar glucose. The Germans have long produced cheap alcoh for fuel purposes from potatoes. It can be used specially designed engines, or a small amount can mixed with gasoline for the usual internal combusti engine. This has been done quite extensively in Eur pean countries. As with everything that depends on crop, we should have to wait for the plants to grow befo we could replenish our stocks in this way. It is doubtf if the acreage could be spared, or the men and machine quickly found to gather, ferment and distill the harve

Alcohol can also be produced synthetically from t waste gases of petroleum refineries. But these gase which a few years ago were allowed to escape into t air or were burned in great flares to avoid hazard, are no much in demand for the manufacture of explosives, sy thetic rubber and plastics, as well as a whole series chemicals required in the war industries. Alcohol is ma from them, but only as a step in the manufacture of e plosives. To make the smokeless powder for a single 1 inch shell requires a barrel of alcohol. It is not likely th alcohol from this source will be available for civilian us

For industrial purposes, methyl or wood alcohol is to large extent used in place of ethyl or beverage alcoho except for such things as perfumes, flavoring extracts an cosmetics. Without much hardship, less use can be mad of products requiring ethyl alcohol. And if a shortag does come, some use of the alternative methods can b made.

SULFA DRUGS AND THE TREATMENT OF WOUNDS

PEARL HARBOR was a sweeping victory for the new sulfa drugs and our soldiers who fight disease and repair human bodies. The Army medical corps was alert, ready, and it scored the world's greatest success in any war in the fight against battle wounds, infections and death.

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In the Army hospitals there were badly wounded men who looked and felt well. They were "amazed" at what they saw. Men who by all past standards should have died were recovering, eager to get back in the fight. There was absence of pus in the men's wounds, mildness of post-operative reactions, and swift, clean healing of wounds. Sulfa drugs plus good organization that gave the wounded prompt attention performed this wonder.

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Fields, and who had not had their wounds cleaned out by debridement for 24 hours, not a single massive infection was found 10 days later.

Infection, which in World War I killed 80 per cent. of the men with abdominal wounds alone, hardly occurred in Hawaii. Compound fractures of bones and injury of the flesh, for instance, showed that less than four per cent. of such injuries became infected. Not a single loss of arm or leg was necessary because of infection. The only amputations reported were those made by the shell splinter or other missile.

Credit for this remarkable record is shared by the sulfa drugs and the efficient preparations of Colonel Edgar L. King, surgeon-in-charge. In the spring of 1941, when most people thought Hawaii safe and such extensive preparations foolish, Colonel King organized all civilian, Navy and Army medical forces to meet possible disaster.

After the attack when the wounded men arrived, their wounds were first debrided, that is, every bit of dead or dying flesh that could give food for germs was cut away. Then sulfanilamide was dusted into the wounds, 68 grams (more than two ounces) at a time. Then each man was given sulfanilamide by mouth, as a further aid in stopping invading germs before they could do any damage. When the first alarm sounded, 14 pounds of sulfa drugs had been brought up from the basement of Tripler Hospital, in readiness for the doctors.

There was no shortage of supplies. Blood plasma banks had been prepared in advance. On December 4, Colonel King had withdrawn 58,000 surgical dressings from the warehouses and put them into the storehouses of the hospitals.

The medical epic of Pearl Harbor ends with two letters, received by General Magee from General Wallace DeWitt and Colonel Emerson, of the Letterman Hospital in San Francisco, where the first contingent of wounded from Hawii have arrived. All the men were in excellent shape. Colonel Emerson emphasized the high morale and cheerfulness of these wounded men, concluding: "They are in the best condition of any war casualties I have ever observed."—JANE STAFFORD.

FREE-TUITION COURSES IN ENGINEERING FOR WOMEN

STEVENS Institute of Technology has announced a twelve-weeks, free-tuition course in engineering, beginning on February 2, for college women with training in mathematics, physics and chemistry. The course is believed to be the first emergency training program to equip college women for technical positions in war industries. It is part of the engineering war training program of the U. S. Office of Education.

The course will qualify women for positions as draftsmen, inspectors, supervisors of women operatives, engine testing, computation and a wide range of precision work.

President Harvey N. Davis, of the institute, pointed out that "Many women whose war service might otherwise be limited to Red Cross, . . . and canteen work, will welcome the opportunity to serve in . . . capacities requiring technical qualifications."

He stated that the course is full-time, serious work eight hours per day, five and a half days a week.

One or more sections, possibly five, of 25 women ea will be immediately organized. Summer courses may offered later to as many as 200 women. They will given the same type of training as men in the short eng neering courses. Following the three-months trainin women will be expected to qualify for employment in w industries. The training is not intended merely to tra women as machine operatives and bench workers, b to enable college women with a knowledge of science use their ability in armament production. Students w provide their own text-books (not more than $5), and suit able clothing for the shop. Tuition and cost of instru ments and slide rules will be paid.

ATHLETE'S FOOT

DR. EDWARD FRANCIS, U. S. Public Health Service me ical director (retired), stands by his remedy for athlete foot of one part camphor, three parts phenol, despi expressed fears it will harm users.

To test the preparation, this writer tried the mixtu as prepared for him personally by Dr. Francis. T writer applied the mixture first to the back of his hand then his feet. No harmful results of any kind were noted However, since this writer happens not to have athlete foot, this was not a test of the mixture as a remedy.

Dr. Francis reported his research in the *Journal* of th American Medical Association for December 6. His d rections are:

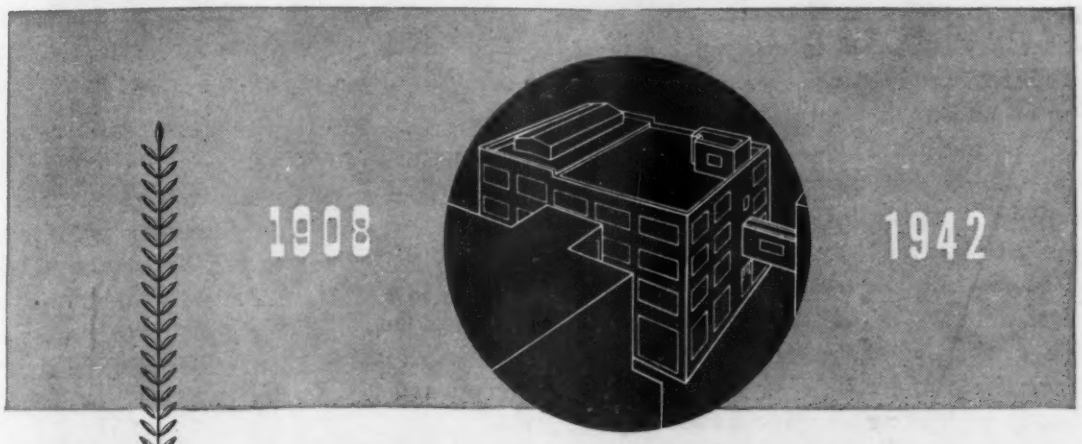
"Melt U. S. P. phenol and measure out 3 cc into mortar; weigh 3 gm of U. S. P. camphor, break into smal pieces and add to the melted phenol. Rub until the entir mass is liquefied. Transfer into a vial with a stoppe suitable for use as a dauber. Keep stoppered when no in use. Experiments indicate that the ingredients may be mixed in the proportion of 3 parts phenol and 1 par camphor.

"The mixture is nonirritating to the skin and may b painted between the toes several times a day, the smal rubber stopper of the vial being used as a dauber. The sock may be replaced immediately without danger of cor rosion. There is no discoloration of the clothing. Relief from itching is immediate. It should be pointed out, how ever, that the phenol-camphor preparation should not be applied to the wet skin, since water causes a breakdown of the preparation, with the result that it becomes caustic."—EDWIN NEFF.

THE STUDY OF EPILEPSY

THAT chronic fits, like epilepsy, have been produced in animals for the first time, was announced by Dr. L. M. Kopeloff, Dr. S. E. Barrera and Dr. N. Kopeloff, of the New York State Psychiatric Institution, at the Baltimore meeting of the Society of American Bacteriologists. Better knowledge of what causes epilepsy in humans will, it is hoped, result from these experiments although the work is too recent to say whether it will lead to means of preventing epilepsy or to better treatment.

The animals, monkeys, rabbits and guinea pigs, de



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veloped epileptic-like fits as a result of a little alum applied to the motor area of the brain. Heretofore fits in animals have been produced by various means, but only one attack resulted. In the animals treated, attacks occurred not just once but continued to occur, for a period of nine months, whenever a loud noise or other stimulus was used to bring on an attack.

Apparently the single alum treatment permanently altered the brain cells so that they reacted abnormally, although they were not structurally damaged or changed.

The animals could be "cured" by medicine such as dilantin now used successfully in treating epilepsy in humans. Brain waves were typical of those seen in epilepsy. Unlike the single attacks of fits previously induced in animals, the chronic state of having fits whenever stimulated did not develop until after an "incubation" period of about four to six weeks after the alum had been put on the brain.—JANE STAFFORD.

THE DUTCH ELM DISEASE

CHEMICAL injections may some day conquer the deadly Dutch elm disease, now extensively ravaging the elm of the northern Atlantic coast states. Hope of bringing this to pass is held out by experiments performed by Dr. George Zentmyer, of the Connecticut Agricultural Experiment Station.

Wilting of leaves, the first noticeable symptom of Dutch elm disease, had long been believed due to simple drought, provoked by the choking up of the sap ducts. Dr. Zentmyer suspected that the wilting might possibly be caused by a toxin secreted by the fungus. This is known to be the case in certain other plant diseases, like tomato and cotton wilts.

He grew a quantity of the elm disease fungus under laboratory conditions and made a filtered extract from it. He dipped cuttings of various plants—snapdragon, tomato, elm, etc.—into the extract. The characteristic wilt developed. The same reaction, as well as the staining of the wood which is another symptom of the elm disease, was observed when injections of the filtrate were made into small trees growing out-of-doors. These tests demonstrated rather definitely that the wilting is due to a toxin, rather than to simple mechanical clogging of the sap channels.

Preliminary tests have been made with a number of counteracting chemicals, and some signs of benefit have been obtained with a few of them, including benzoic acid, hydroquinone and 8-hydroxyquinoline benzoate. Much further research, however, is considered necessary before recommendations for general use can be safely made.

ITEMS

DRILLING a hole through a piece of hard steel with nothing more substantial than a tiny jet of salt water sounds fantastic. Yet this is just what Dr. Charles F. Burgess, former professor of chemical engineering at the University of Wisconsin, demonstrated before a meeting of the Electrochemical Society of Chicago. The hardest of metals, he said, can be drilled in this way, even tungsten carbide which can otherwise only be cut with a diamond. The jet of salt water issued from a glass nozzle directed toward the steel plate. This nozzle was connected by a sealed in wire with the negative pole of a batte the positive pole of which was connected to the pl Thus an electrical circuit was established from the batt to the plate, up through the jet and back to the batte The salt in the water made it a good conductor of el tricity.

AMERICA'S first winter sportsmen crossed from Asia Alaska some 2,000 years ago, bringing with them the b and arrow, snowshoe and toboggan. They constituted t last great aboriginal invasion of North America, p ceding the Christian era by only a short time. This the theory of Dr. Diamond Jenness, of the National M seum of Canada, described in the latest annual report the Smithsonian Institution. These latest invaders, call Athapascans, chased the Eskimos from the Macken River basin to the northeastern coast of Canada, ev tually Greenland. From these Eskimos descended t Algonquin Indians, who greeted the first English settl on the Atlantic seaboard. Only about a thousand ye ago, the Athapascan descendants reached the southweste part of this continent, and from them descended t Navajo Indians of to-day. Dr. Jenness reconstruct this picture from archeological remains and from li guistic evidence.

CONSTRUCTION of the first "shoe sterilizer" on Sh pard Field, the newest and largest air corps techni school of the Army, was ordered recently by Capt Morton Hack, commanding officer of the 408th Sch Squadron, Air Corps Replacement Training Center, Sheppard Field, Texas. This instrument designed Captain Hack is designed to sterilize forty-five pairs shoes at one time, and it is hoped to prevent and eli nate any cases of ringworm among members of t squadron. The wooden cabinet, now being built by P vate First Class Bill Jenkins, carpenter of the squadr will be airtight and built on wheels. When finished it w be 5 feet high, 2 to 3 feet wide and 2 to 3 feet dee It will have partitions in the interior built to conta forty-five pairs of shoes at one time with the contain air circulating freely throughout the interior. On t bottom of the container will be a metal dish for che icals. The shoes will remain in the sterilizer with che ical vapor overnight.

THAT long, dull ache remaining in the jaw after a too has been pulled can be mercifully reduced by drug, pa nitrobenzoic acid, which is allied to the sulfa drug It is also the most deadly of all its relatives against t germ found most frequently in infected tooth socket *streptococcus viridans.* This is reported by Drs. C. J Griffith, A. D. Hirschfelder and W. J. Simon, of the di sion of oral surgery, University of Minnesota Dent School, published in the *Journal* of the American Dent Association. In routine extractions (not impacted teeth the dentists found that with use of the para-nitroben acid, pain occurred in only three, or .6 per cent. of 5 cases. Of 7,060 cases not given the acid, 353, or 5 p cent., had pain following the extraction. While the ac treatment did not reduce pain following surgical extra tion of impacted teeth, it did reduce the number of tre ments needed after extraction.